McGraw-Hill
Publishing Company, Inc.
James H. McGraw, *President*
Mason Britton, *Vice-President*

POWER

Editor
Fred R. Low
General Manager
Irving Fellner

Volume 68 New York, October 16, 1928 *Number* 16

An Acknowledgment

THEY crowded me off my page last week. My blushes rival the reddening foliage of the New Hampshire hills among which I read the testimonials with which they replaced my foreword.

I suppose that one may without vanity be glad to have won the esteem of one's fellowmen and gratified at their expression of it, but I have done little to warrant such a tribute.

And against it as a background one's conscious faults and shortcomings loom large.

It is nothing to my credit that I grew old upon the job. The years just went by and I could not stop them.

And forty years' time can of itself do a whole lot.

It has wrought an enormous development in the field of power with boundless opportunities for those who were connected with it.

Power naturally shared in the progress. It was my good fortune to be at the wheel.

The best of the opportunities that its editorship has brought to me have been those of meeting and knowing men.

And my greatest gratification as I grow old in its service is that the contacts to which that service has led have brought me so many good friends.

To the authors of the published letters and to those who, since the appearance of the paper, have sent messages and letters of congratulation, I present my grateful acknowledgments. I am glad to have been fated and permitted to serve for them and with them and proud of and happy in their friendship.

F. R. Low

POWER *Stands for . . .*

1. Making Power When It Should Be Made
2. Buying Power When It Should Be Bought
3. Cheaper Power Through Modern Equipment
4. Easier Financing of Equipment Purchases
5. Better Use of Byproduct Heat and Power
6. Operating Methods That Save Money
7. Less Waste in Transmission and Application

Operating Methods That Save Money

AN OPERATING method that can be employed with profit, although it is often neglected, is the full and proper use of instruments. This might be called the "factual" method, or basing of operation upon precise data.

A phase of this that is of particular merit is the use of flow meters in plant service work. Much money has been saved by finding just where the steam goes and then studying to keep its use at a minimum. One large soap plant, after installing flow meters and then basing its operations on the information obtained from them, found that a contemplated addition to the boiler house was unnecessary and that one production department, previously in red ink, became profitable.

Another example of improving operation through the use of instruments is given in the article by W. S. Everham, published elsewhere in this issue. These examples, and others readily brought to mind, leave no doubt that one successful operating method lies in taking full advantage of the services of these faithful power-plant servants.

Increased Power Versus Unemployment

THE fear of President Green, of the American Federation of Labor, that increased use of power and modernized labor-saving equipment is displacing labor at an alarming rate, is ill-founded. He concedes that new industries and greater social needs have thus far largely absorbed workers displaced by machinery, but he expresses some fear lest the point of saturation be near.

The increased use of power, accompanied by greater production and high wages, higher standards of living and more time for the enjoyment of luxuries, tend to relieve the displacement of labor by a gradual reduction in the hours of labor. Moreover, the best solution to this labor displacement problem lies in the fact that the increased use of power and the use of modernized equipment is creating new industries and new markets. Workers should place confidence in the ability of American business to absorb labor through the creation of new industries and new markets, as it has so ably done in the past.

The increased use of power and the use of newer and more effective labor-saving machines is a great boon to humanity, even though these machines replace men, because they increase output to a degree impossible with hand labor and less efficient use of power. The increased use of power and automatic machines has consistently added to the sum of human welfare and to the prosperity of those who use them.

What most observers forget is that new opportunities come in the wake of old ones. Prosperity is not a matter of limiting production. It is a matter of making production as efficient as possible and then of seeing to it that markets are opened and kept open for the increased output that is made possible by new and scientific methods and greater use of power. Labor will thereby have new lines of endeavor in new industries and occupations created by the increased use of power and improved machinery.

Rating of Diesel Engines

HARDLY a public letting is held for the purchase of a Diesel engine that a heated controversy on the subject of the rating of the engines offered does not arise. With the consulting engineer or the purchaser but indifferently acquainted with the behavior of different engines, it is little wonder that the acrimony among the tenderers invokes distrust and suspicion.

Too much stress has been laid upon the mean effective pressure used in computing the brake horsepower. If one designer can produce an engine in which the combustion is so excellent that it can burn enough fuel to develop a mean pressure of over one hundred pounds while obtaining a good fuel consumption, and a second can show but one-half this pressure, why penalize the better achievement? The ready answer is that such high pressures result in intense heat stresses, leading to eventual disaster.

But is the mean effective pressure an indicator by which to measure the internal stresses? Is it not necessary to consider also the fuel economy?

In steam-engine and turbine work it has long been recognized that by plotting the total fuel consumption against the developed horsepower, an almost straight line, the Willans line, was produced. If this procedure be followed with the oil engine, the resulting inclined line is almost straight, resembling its steam-engine prototype to a marked extent. However, somewhere in the neighborhood of the engine's rated horsepower the line curves sharply upward. This deflection indicates that the engine is experiencing more losses per horsepower than before. As the mechanical efficiency increases with the load, these losses are evidently those of the jacket water and exhaust.

The increase in these two losses is traceable to defective combustion. If there is a delay in the rate of combustion, the heat stresses will naturally rise and in time cause trouble. For this reason it would appear that the engine rating should be held at some value below the point at which the Willans line begins to curve sharply upward.

With this method of rating the successful designer is not penalized and it should be possible to work out characteristic curves, for each engine of the same general design behaves with marked uniformity.

Better Be Safe Than Sorry

WHEN Ed Howe gave the advice that appears at the head of this editorial, he could have had no conception of the motor traffic that would clog modern streets and highways. Nor could he have foreseen the enormous toll in death and accident that this traffic demands.

Although this is one of the most serious problems now facing the country, public interest is not aroused. When a few persons are killed in a railway or industrial accident, people are up in arms and besiege the authorities with demands for investigations and reprisals. When war kills its thousands and maims its tens of thousands, the pressure on government to act to abolish war becomes tremendous. But the casualties from street and highway accidents mount higher than from the field of battle, and nothing much is said or done.

It is a hopeful sign, therefore, that the Seventeenth Annual Safety Congress, held recently in New York City, placed first emphasis on the importance of greater safety in traffic. It is to be hoped that this action bears fruit. And it will, if only everyone does his part. The result, in lessened suffering and sorrow, will be many times worth any effort involved.

A Bad Name Is Hard To Live Down

A BAD name sticks to power equipment much as it does to human beings. For instance, take the synchronous motor. Early types of these motors had low starting and pull-in torques, and when put into service, were likely to give trouble unless conditions were favorable for their operation. In some cases the motors were started by a separate source of motive power and synchronized similar to an alternating-current generator, after which the load was applied through a clutch. This is the picture of the synchronous motor which is still in the minds of some plant engineers, though now far from the facts.

The modern synchronous motor has largely outgrown all the bad qualities of its early days and is superior in certain respects to other types of alternating-current motors. Instead of requiring a source of motive power for starting, they can be obtained to develop a starting torque of one hundred and fifty per cent of normal full load and will pull into step with over full rated load. Furthermore, if the load reaches a value to cause the motor to pull out of step, it will resynchronize when the load decreases to near normal rating. This performance is obtained with reasonable inrush currents.

Another erroneous idea inherited from other days is that the synchronous motor can be used only in large sizes. Modern slow-speed designs can be had as small as twenty horsepower. The starting of synchronous motors is frequently considered a complicated operation. This again is an inheritance of pioneer days. These motors are now as readily started and stopped automatically as the induction types. In addition, their power factor can be controlled, which may be an important feature in the cost of power.

The synchronous motor is not now, and never will be, suitable for all alternating-current motor applications, but it has been brought to a state of development where it has an economic place in practically every industry.

Profits of Modern Industry

CRIES of "profitless prosperity," arising from many quarters, arouse interest as to what the true profit situation in industry is. The facts are hard to come by, and even the expert statistician has difficulty in making his studies broad enough to yield trustworthy data. Because of this the recent release of an analysis made by the National Industrial Conference Board is welcome.

This study is based upon the profit ratios to sales and capital investment in more than four thousand large and successful enterprises, and consideration of the operation of all other corporations. It developed that fifteen per cent of the sales made in the country from 1918 to 1925 realized a loss, while the remaining eighty-five per cent realized profits ranging from over twenty per cent to zero. The losses do not necessarily represent operation of any one company completely at a loss, for most realize a profit on some sales and a loss on others, with an over-all profit.

Conclusions from the detailed figures are that all competitive businesses are now operated on small profit margins. This need not result in a low return on capital, for the tendency is to accelerate capital turnover and realize a relatively high return.

It would seem, then, that those who experience "profitless prosperity" are not sufficiently well organized or operated to obtain enough volume of business at a low return to maintain their competitive position and reap the profits that are known to reward large-scale operations. The causes of this condition may be many, but it is obvious that one of them is the uneconomical use of power. However small the part power may play in making the total production cost, anything saved in its use is a real aid in the avoidance of business losses. Engineers who see to it that the cost of power entering into the finished products of their factories is always at a minimum, make an essential contribution toward the profitable prosperity of their companies.

Don't Blame the Materials for

REFRACTORY FAILURES

Caused by Bad Furnace Design

Refractory failures are not always due to the materials. Often they may be attributed to improper furnace design, overloading of the refractory, mechanical stresses set up in operation and other defects. Such troubles may be corrected by less expensive means than the use of superrefractories and air or water cooling

By Hugh E. Weightman

OFTEN one of two furnaces serving identical boilers and having similar operating conditions, may require more frequent repair than the other. In searching for reasons, the author has studied the mechanical stresses set up in operation and has found causes for many heretofore unexplained irregularities in furnace life.

Factors most often talked about in boiler plants are the effects of expansion, the use of thin or thick joints in brickwork, and the application of packings of asbestos or similar substances between bridges or arches and the walls. It is evident that one type of brick setting will not do for all furnaces.

Furnace walls are tied in place by buckstays. These cast-iron or steel pieces are held together by steel or wrought iron rods. If these rods are proportioned properly, no excessive load will be thrown on the brickwork, and under these conditions any good masonry work will stand up. If thick joints are used in high walls, failure may result from the crushing of the jointing material or perhaps from the melting of a low refractory mortar. Tierods or bars, if properly placed on the exterior, will act in the same manner as reinforcing in concrete. Under such conditions, whether the cracks in the wall will be fine and closely distributed or wide apart and consequently deep and dangerous, will depend on the steel-refractory ratio. Too much steel often tends to cause cracking from expansion, but the cracks are fine and seal over by firing. Insufficient steel causes large cracks in the furnace wall.

In any design it is important to be sure of the temperatures to which the steel is subjected. The coefficient of expansion of the average soft structural steel is taken usually as $650 \div 10^8$ lin.in. per deg. F., but the figure varies from 605 to 734, depending upon the composition and hardness of the steel; wrought iron may be taken at 633 and cast iron at 590. Firebrick ranges from 300 for hard-burned to 700 for soft-burned, the average approximating 450. These figures refer to shapes that have been refired repeatedly or have been under continuous service for not less than two to three weeks. Before that period there may be considerable shrinkage to mask the expansion. The failure often starts on an inner course under moderate temperature, for here the expansion is greatest, as there is not sufficient temperature nor a furnace atmosphere to cause a compensating shrinkage.

Fig. 1—Damage shown here to bridge-wall brick above waterback is probably due to movement of waterback from expansion

Improperly proportioned tierods and buckstays throw heavy stresses on the brickwork. Two features are involved, one the rate at which the metal expands with rising temperature and the other the tenacity or stiffness

of the metal. When external forces, such as heat in this instance, act on a material, they produce tension, compression, bending, stresses within the material, and in most instances a combination of these stresses. If the stress is not too great, the material will return to its original state when the stress is removed, unless the elastic limit has been exceeded, so that it is necessary to work the materials within this limit.

Fig. 1 is a photograph taken through an observation door while a chain-grate furnace was in operation. The customary damage to the refractories is shown directly above the waterback. It has been commonly assumed that this destruction is due to melting, assisted by the abrasion of the ash. That such an assumption is erroneous can be shown by referring to Fig. 2. Here the intense flame has left its mark on the refractories by glazing them back to a point a few feet from under the arch. Beyond this point the presence of adhering ash shows that the natural buoyancy of the heated gases caused them to rise rapidly to the heating surface. Under these conditions temperature cannot be the cause of the extensive damage to the bridge-wall brick. It is true that some melted material is shown in Fig. 1, but this may be low-melting ash. The latter has a tendency to flux with the brick and wear down a wall, but when the damage is due to this action, the brick wear smoothly and do not present conchoidal fractures. In the event that a large spall takes place under sufficient temperature for fluxing action, the sharp corners are at once rounded off. None of these effects is indicated in Fig. 1.

An analysis of several waterbacks discloses that in the majority of cases refractory trouble is due to movement of the waterback. If the connections to the waterback are rigid, the latter has a downward deflection during operation, thus removing the support from the bridge-wall refractories. This results in loosening of the wall and heavy spalling action. In one case a wrought-iron pipe waterback had an initial camber of one-half inch when installed, and the deflection tendency was upward. The resistance of the bridge wall to movement was sufficient, so that only at the points where the waterback entered the side walls, was considerable breakage and spalling evident. In this case making a more flexible connection to the waterback and packing the pipe loosely in the wall caused all bridge-wall damage at the ends to cease.

Fig. 2—Spalling of tile end pieces in arch from heat on two faces

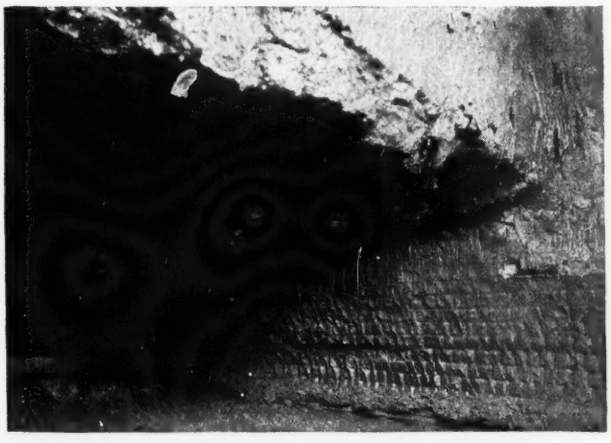


Fig. 3—Heaviest spalling under longitudinal hanger nearest the side wall

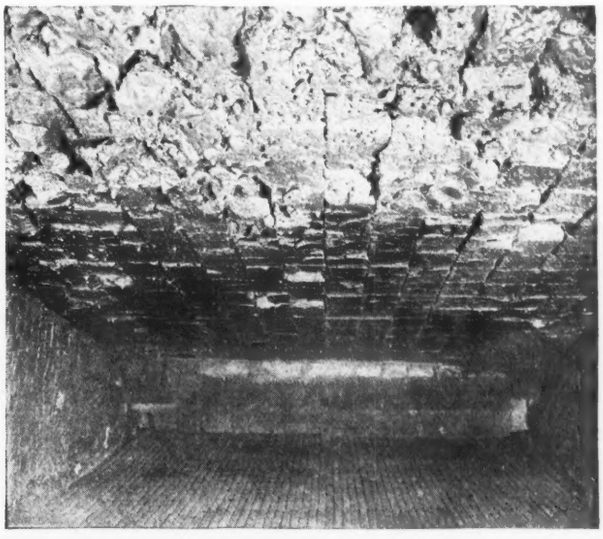


Fig. 4—Effect of stresses set up by misplaced hanger equipment

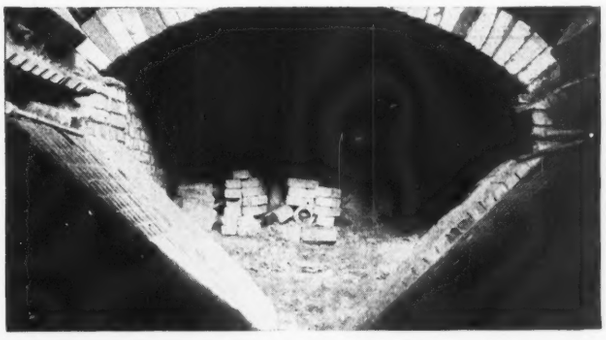


Fig. 5—Sprung arch of odd radius made from stock shapes

For waterback construction, then, the following rules may be set down: Be sure of sufficient freedom of movement for the pipe, so that its expansion will not cause a deflection; make sure that the waterback is straight, or, if cambered, that it be placed with the convex side up; provide a flexible refractory packing between the side walls and the waterback.

It is to be noticed, in Fig. 2, that the large tile end pieces are badly spalled. Such action may be due to several causes, the most frequent being the placing of

large sections so that they are heated on the two outer faces forming the corner. The stresses set up cause shearing action sufficient to disrupt the strongest refractory. The remedy here is thinner sections and a fan-tail construction to avoid heating two sides of a single piece.

Another source of trouble is the practice of riveting the I-beam supports for the arch and curtain wall to the boiler columns. Under such conditions any damage to the arch allowing a higher temperature to be given to the beams causes them to exert sufficient pull on the boiler columns to throw a heavy load on the side wall at the end of the arch. As the brick temperature is highest at this point, the usual result is a thickening of the corner and spalling of the end of the arch. This effect is clearly evident in Fig. 2, which also shows a heavy crack in the side wall from this loading.

Fig. 3, a view of the left-hand side of the furnace, shown in Fig. 2, indicates that the heaviest spalling in the arch is near the side wall where the shear is maxi-

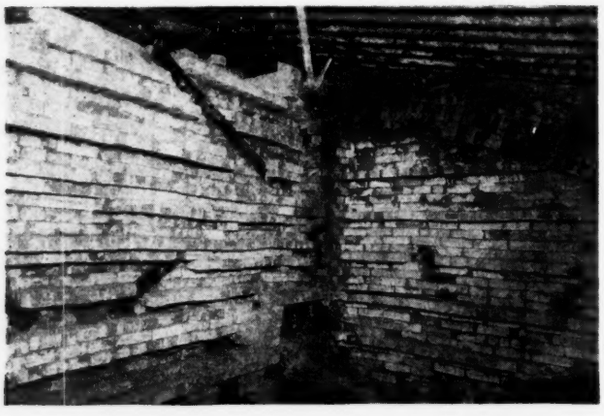


Fig. 6—Firebrick arranged to split up plastic walls

mum. In many cases the point of maximum shear is at either the side wall or, as in the present instance, under the longitudinal hanger nearest the side wall.

The effect on good arch refractories from stresses set up by misplaced hanger equipment, is shown in Fig. 4. Whenever hangers have been heated to excessive temperatures, it is necessary, when rebuilding the arch, to be sure that all warped sections have been replaced or straightened. For this reason arches with flexible and replaceable hanger elements are to be preferred.

In Fig. 5 the attempt has been made to use stock shapes to turn a sprung arch of odd radius. Some wedges have been inserted upside down. This particular furnace arch lasted three weeks. Designers should be careful to select radii that permit the use of standard shapes of as few sizes as possible. In most cases only one size of wedge or key should be used.

Another example of poor construction is that of using a double row of arch brick to spring a 9-in. arch. The idea back of this practice was to allow a 4½-in. renewal and thus save the upper half of the arch which would be lost in the case of the wedge brick. However, the temperature of the lower arch is higher than that of the upper one, and the expansion causes the center of the lower arch to push upward with sufficient force to loosen the bonding material of the upper arch. Thus the load of the upper arch is thrown on the lower one, causing spalling and grooving action on the fire face.

Plastic furnace refractories are finding greater use each year. In the past such materials were pounded into furnaces in large sections with no means for taking care of tension and shearing stresses from temperature effects. The results were large cracks at points within the furnace. A thoroughly burned firebrick has greater strength than a plastic refractory heated only from one

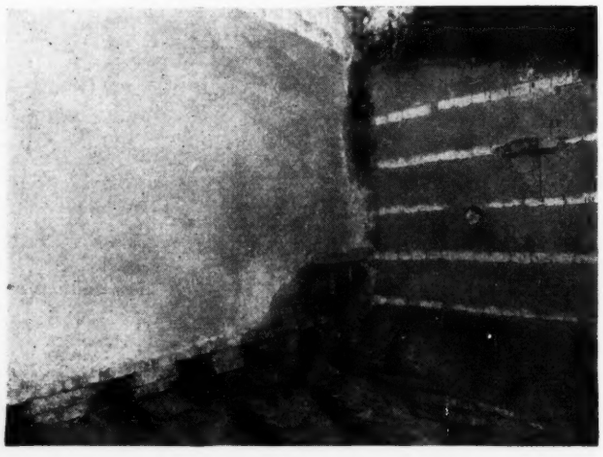


Fig. 7—Plastic applied to walls of Fig. 6

side. Consequently, splitting up the plastic walls with firebrick sections gives in effect the same thing as putting steel in concrete. Figs. 6 and 7 indicate one way this may be done, the former showing the furnace ready for lining and the latter, the completed job. This is con-

Fig. 8—Sprung arch of plastic refractories with iron reinforcement

sidered good practice for important installations where walls are more than five feet high.

A sufficient amount of iron reinforcement in the case of Figs. 8 and 9 avoided large shrinkage and only hair cracks were visible. The use of steel is too new to set up rules for reinforcement, but it is probable that sufficient data will be available in the near future to guide practice in this method. Elastic limit and shrinkage characteristics of portland cement are fairly well known, but these data will not do for plastic refractories.

In Fig. 10 is shown the effect of too large section in tierods. The arch was of excellent material and the furnace had not been fired to an excessive rating. The

skew blocks were rigid and the brick had been set with a thin joint. Steel plates distributed the load over the entire side wall. Except for the defect in tierod construction the design was good. Slacking the tierods reduced the formation of stalactitic slag, but when an arch was put in new with slackened tierods (just slack enough to prevent excessive loading on the blocks), the arch had a tendency to slip and spall. Finally, the rods

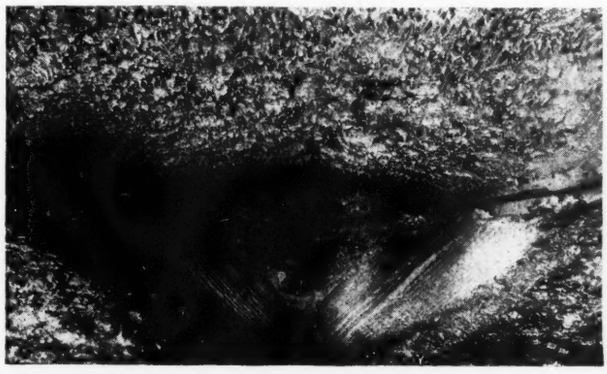


Fig. 9—Arch of Fig. 8 after operation. Reinforcement eliminated large shrinkage, so that only hair cracks were visible

were drawn to a thinner section to keep the loading on the arch within reasonable limits, and further trouble was avoided. The arch lasted eighteen months as compared to seven months, the longest life previously obtained.

Ignition arches are often damaged by the thrust of the buckstays used in certain stoker installations. Even with a correct tierod section the ignition arch may be

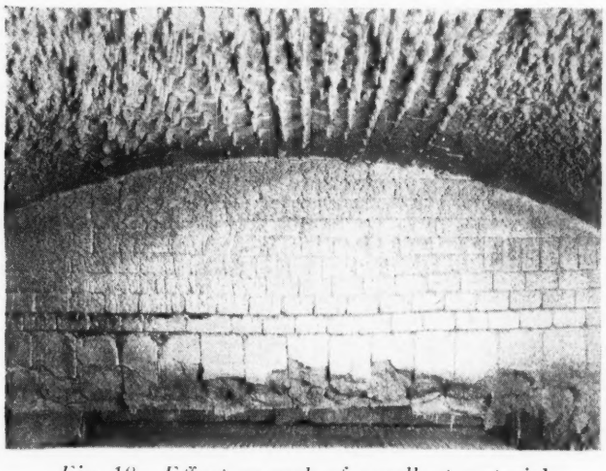


Fig. 10—Effect on arch of excellent material from too much section in tierods

loaded too heavily, owing to the rigidity of the buckstay and its placing in concrete. Where buckstays and boiler supporting columns are set in a rigid concrete base and the concrete line is within three feet of the elevation of the ignition arch, it is desirable to leave a space between the plate and column to be taken up by shims.

Clean-out and observation ports in side walls are often a source of difficulty. It is usual practice to build the arch over these ports. The heat from the furnace tends to split off corners. The load of the wall above against the upward thrust of the arch element, owing to temperature, crushes the arch, and when the furnace cools, bricks drop out. A better construction is to carry the arch past the sides of the port. Where high walls are used, it may be desirable to introduce a relieving arch or insert steel beams to carry the load above the port.

Gage Glass for High-Pressure Boilers

WITH the trend toward the use of higher steam pressures the problem of selecting boiler gage glasses has become increasingly bothersome. In a paper delivered before the congress of the National Safety Council in New York, William A. Tucker gave the following specifications for gage glasses to be used with steam pressures up to 500 lb. per sq.in.:

Gage glasses shall be of the best quality, free from internal strains and all inperfections, cut to proper length, fused at the ends; shall be straight and of uniform bore and diameter throughout their length. The maximum outside diameter shall not exceed the nominal diameter of the glass called for, and a minimum acceptable diameter shall be $\frac{1}{16}$ in. less than the nominal diameter.

It should pass the following shock test:

The glass to be tested is installed in the fitting; the valve in the water line is opened until the glass becomes half filled with water at a temperature of 75 deg.; the quick-opening valve in the steam line is then opened and the glass is suddenly subjected to steam pressure of 270 lb. gage pressure. At the end of one minute the quick-opening steam valve is closed, and by opening the discharge valve the steam and water are allowed to flow from the apparatus. Cold water is then passed through the glass until it becomes cool, when the above operations are again repeated, until fifteen operations have been successfully withstood or the glass breaks.

Three glasses shall constitute a complete test, and the average number of successful operations shall not be less than ten. In order to protect the operator from injury by flying particles of glass, a heavy wire screen and metal guard should be placed around the glass and apparatus during the test.

Power Services—1928 Model

No one likes to drive a 1920 car, but that is largely a matter of pride and comfort. For the more important reasons of efficiency and economy, no engineer wants to struggle under the handicap of power services operated and equipped in obsolete manner.

But many who would like to shed such a burden and realize the advantages of modernization may not be thoroughly familiar with modern practice. They will find much help in POWER *for November 27, which will be entirely devoted to this subject.*

Remote Control of

OIL CIRCUIT BREAKERS

By S. Q. Hayes
General Engineer,
Westinghouse Electric & Manufacturing Company

Different systems of remotely controlling switching equipment are compared, the voltage used on operating coils, signal lights and alarm systems are given and methods of interlocking the operation of two or more switches are discussed.

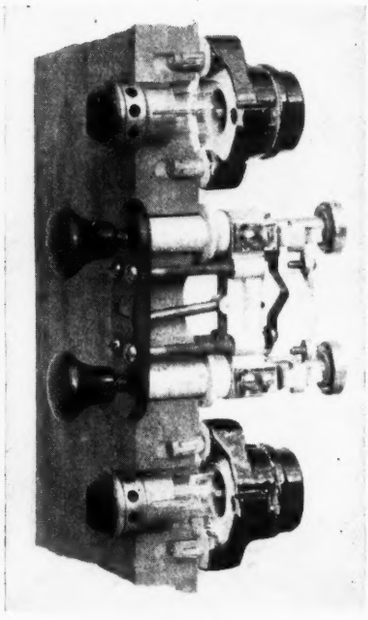


Fig. 1—Twin pull-button type of control switch

ON ALL the larger electrically operated oil circuit breakers control-relay panels or their equivalent are furnished. Such a panel normally contains a relay to provide a trip-free feature for the control system, thus preventing the operator from holding a breaker closed on a short circuit.

Standard electric mechanisms for oil circuit breakers are regularly supplied with coils having operating ranges for the closing coil of 90 to 140 volts and for the tripping coil 70 to 140 volts for the nominal 125-volt control. Where 250-volt control is used, the closing coils have a range from 180 to 280 volts, the tripping coils 140 to 280.

Where electrically operated breakers are to be used as the equivalent of a double-throw breaker, electrical interlocks of the control wiring can be accomplished through the signal switches in such a way that the closing circuit of breaker No. 1 passes through the signal switch of breaker No. 2 and is completed only when breaker No. 2 is in the open position. In a similar manner the closing circuit of breaker No. 2 passes through the signal switch of breaker No. 1. With such an electrical interlock only one of the two breakers can be closed at the same time. A five-point drum control switch can be provided, so that with the breakers in the open position either one or the other can be closed and the control switch can be later utilized to trip out whichever breaker has been closed.

Other suitable interlocks with drum control switches can be provided to insure a certain sequence of operation, for instance for starting an alternating-current motor by means of reduced voltage. In such a case the drum control switch would first close the electrically operated breaker energizing the auto-transformer, as well as a second electrically operated breaker connecting the motor to low-voltage taps of the auto-transformer for starting purposes. A further rotation of the drum control switch would then trip out the starting breakers and immediately throw in the running breaker. Another movement of a control switch could later trip out the running breaker for shutting down the motor.

Control switches, particularly of the rotary type, can be provided with different combinations of stationary and moving contacts in order to accomplish various desired results.

A push button for closing a control circuit and another for tripping was an early scheme adopted to do away with live contacts on the front of the board. The push button had the disadvantage of being liable to accidental closing by the switchboard operator, so pull buttons were substituted and these were made either single or double.

For many years the General Electric Company standardized on twin pull-button switches, and they have made certain modifications of this device. One of this type is shown in Fig. 1. Red and green indicating lamps with suitable lenses are used for signals, and a little target colored red and green located between the pull buttons shows the last movement that has been made. If the target shows one color and the indicating lamp another, the attendant knows that the breaker has tripped automatically.

The Westinghouse company adopted a drum control switch that possessed features difficult to embody in a pull-button device. By varying the drum development and the number of contact fingers, different interlocks could be made and a single control switch arranged to handle the three electrically operated breakers for motor starting, the forward and reverse motion with limit switches for governors, valves, rheostats, etc. Fig. 2 shows a design of drum control switch. The device is essentially a multi-circuit double-throw switch designed to secure space economy, while having due regard for proper insulation.

All control switches of this type for circuit breakers are provided with a mechanical indicating device which shows the last manual operation of the control switch. When the handle is released, the switch automatically returns to the neutral position. Most of these switches for the control of solenoid operating breakers embody a signal-lamp cutout. After tripping the breaker, the handle on the control switch may be pulled out while in the tripped position, thus latching it into place and at the same time opening both the trip circuit and the indicating-lamp circuit. This feature reduces the load on the control battery and differentiates between breakers opened manually and those opened automatically.

The General Electric Company recently placed on the market a rotary control switch that may be described as

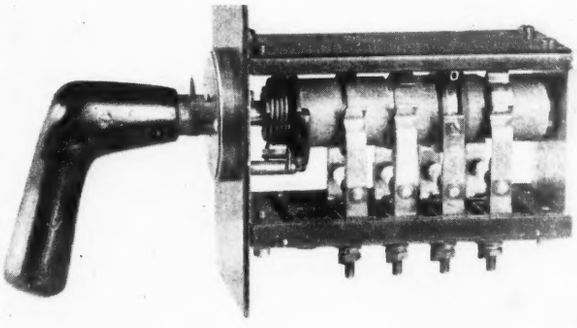
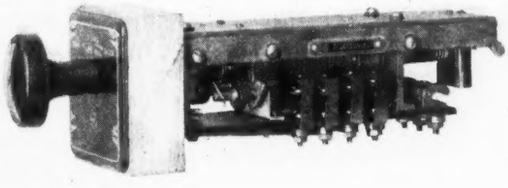


Fig. 2 (Above)—Drum-type control switch that is essentially a multi-circuit double-throw switch

Fig. 3 (Below)—Rotary-type control switch that is a combination pull and turn switch



a combination turn and pull switch. The turn-pull control switch shown in Fig. 3 is used for the control of electrically operated air or oil circuit breakers. This switch is of the multi-contact design.

With any system of distant control apparatus it is necessary for the operator to know whether the different breakers or other apparatus are actually closed or open or have performed the function assigned to them.

With some of the earlier electrically operated switching equipments electro-mechanical telltale indicators were provided, but essentially all modern American equipments use lamp indicators, which are connected in the control circuit of electrically operated breakers to indicate whether the breaker is open or closed.

The lamps are usually so connected with the signal switch on the breaker that when the breaker is closed the red indicator will be lighted and when the breaker is open the green indicator will be lighted. On one type of control switch an additional indicator is so connected

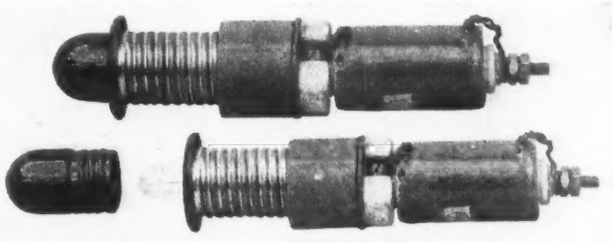


Fig. 4—Indicating lamp with self-contained resistor

to the signal and control switches that when the breaker is tripped automatically the indicator is lighted and remains lighted until the control switch is turned to the open or closed position, this being the equivalent of the mechanical indicating device that is self-contained on certain control switches.

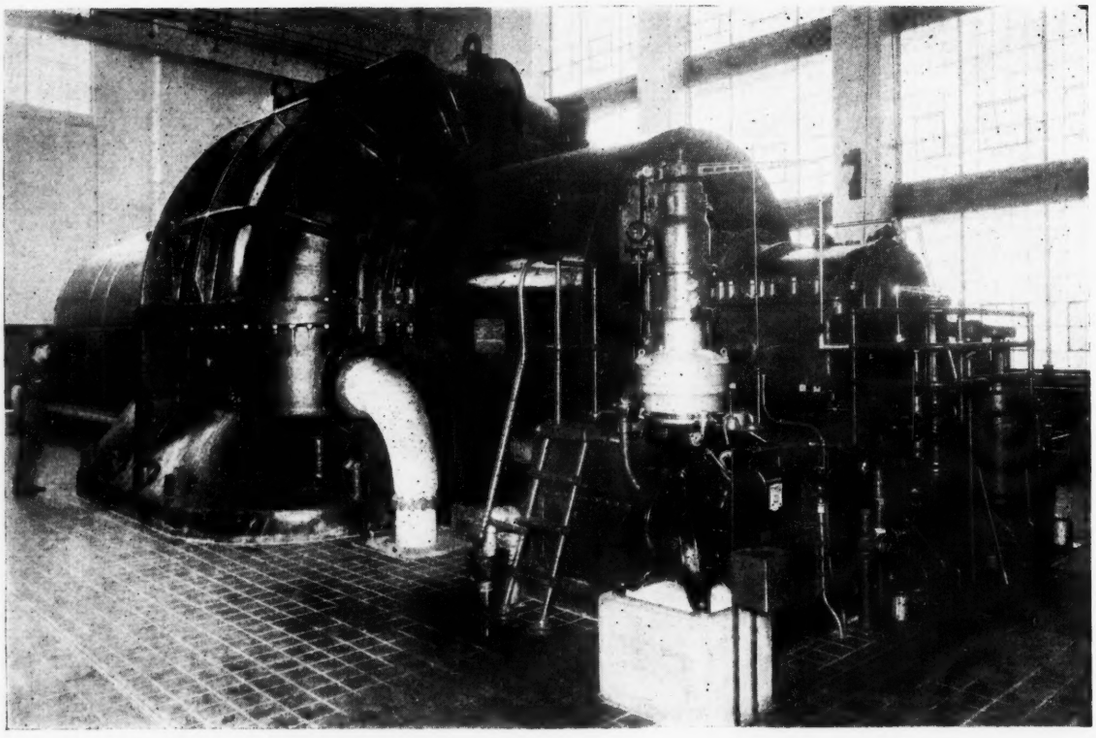
Some of the earlier indicating lamps were used across the full control voltage of 110, but most of the later indicators use lower-voltage lamps with a series resistor.

Fig. 4 shows an indicating lamp with a self-contained resistor. Each of these receptacles requires but a single mounting hole in the panel and permits considerable space saving. Heating is minimized by the greater radiating surface and having the lamp bulb extend from the panel. A covered cap is screwed over the lamp, and the illuminated cap is visible from any position in front of the switchboard.

It is now general practice to use low-voltage indicating lamps with series resistors. This permits operating the red signal in series with the trip coil without danger of tripping the breaker if the bulb is short-circuited. The advantage of this telltale connection is that the red signal will not only show that the breaker is closed, but also the trip circuit is intact ready to function if required.

For indicating when a breaker is opened automatically, an indicating lamp with clear-color caps is supplied and a resistor with a tap is provided by the General Electric Company, permitting operation at approximately 50 per cent above or below the voltage of the red signal light. With this "dim-bright" connection the lamp will show bright while the alarm is sounding, thus identifying the breaker that has automatically opened. When a breaker is tripped by means of the control switch or when the handle of the control switch is caused to remain in the off position after the automatic opening of a breaker, the lamp with clear-color cap will show dim.

When a breaker is closed by means of the control switch, the alarm will sound, if quick acting, and the clear light will show bright during the brief period required for the opening of the auxiliary switches after the closing control circuit is completed, thus testing the alarm and "dim-bright" arrangement while closing the breaker. If, for any reason, a breaker fails to close in response to the operation of a control switch, the alarm will sound and the clear light will show bright until the handle is returned to the open position.



Things You Must Watch to Secure Efficient

STEAM TURBINE LUBRICATION

By HAROLD L. KAUFFMAN
Petroleum Consultant

FOR satisfactory operating results, care should be taken in the selection of the proper grade of steam-turbine lubricant and close attention should be given to it at regular intervals in service.

Steam-turbine lubrication demands the use of lubricating oils of the highest quality, because the lubricating systems are usually so arranged as to permit the continuous use of the same oil for an indefinite period, with the addition of "makeup" oil.

Selection of the proper grade of oil in the first place is generally influenced by the manufacturer's recommendations. By "proper grade of oil" we here have reference primarily to oil of suitable viscosity.

A few words in explanation of the term viscosity might well be given at this point. It is a relative measure of the resistance of oil to flow. In other words, it is a measure of the internal or fluid friction, the friction created by the moving of one particle of oil over another. The more viscous an oil—that is, the greater the fluid friction—the greater are the power losses. Viscosity is expressed in seconds, as usually determined on the Saybolt Universal viscosimeter. Briefly described, a determination consists in heating 60 c.c. of the oil to be tested to a definite temperature (usually 100 deg. F.) and then allowing it to flow through a standard orifice. The time in seconds required for the oil to flow through the orifice is the measure of the viscosity of that oil.

In Bureau of Mines Technical Paper 323 B, "United States Government Master Specifications for Lubricants and Liquid Fuels," the viscosity at 100 deg. F. of the five grades of oil used by the government and its agencies for the lubrication of turbines, dynamos and high-speed steam engines using circulating and forced-feed systems, is given as follows, in viscosity in seconds at 100 deg. F.: Extra light, 135-165; light, 180-220; medium, 270-330; heavy, 360-440; extra-heavy, 450-550.

However, there is much lack of uniformity among oil companies and between their specifications and those of the United States government as to the viscosity that should be possessed by different grades of turbine oil.

As an example of this condition, here is how one oil company grades its turbine oils in viscosity in seconds at 100 deg. F.: Light, 140; medium, 180; heavy, 300; extra-heavy, 550; special-heavy, 725. This oil company's light turbine oil is the government's extra light; the oil company's medium, the government's light; the oil company's heavy, the government's medium. The oil company has no grade of oil comparing in viscosity to the government's heavy grade, while the government in return has no oil comparable to the oil company's special heavy grade. Only in the extra-heavy grades of oil is there a similarity between the two.

This illustrates the present state of affairs in the grading of turbine oils, a highly unsatisfactory condition for the user. In view of the way matters stand, the writer recommends that when steam turbines are installed information be obtained from the manufacturer as to the viscosity of the oil recommended; and that thereafter, assuming the use of oil recommended by the manufacturer to have been satisfactory, oil be bought on a viscosity specification (among others) instead of merely ordered by trade name, as is now too common practice.

A turbine oil must separate freely from any water that may be agitated with it at any temperature. If a temporary emulsion forms, the water should separate completely from the oil upon subjecting the whole to a temperature of 175 to 180 deg. F.

The fact that steam-turbine oils must not emulsify has been long recognized by manufacturers of steam turbines. As a matter of fact, in a circular letter issued by one of the steam-turbine manufacturing companies to its erecting engineers it is stated: "One of the most prolific causes of trouble with steam-turbine oils is their emulsification into a more or less jelly-like substance when water becomes mixed with certain oils, a condition that is very likely to happen. It has been found that high-viscosity oils are more prone to this difficulty than oils of low viscosity. It is therefore very important that the oils used be capable of readily breaking from water and of not emulsifying when violently agitated."

The oiling system of the steam turbine is not very different from that of the steam engine, and in fact many steam engines have systems identical with those generally employed on steam turbines. Like the steam engine, the efficient operation of the steam-turbine is handicapped by the ever-present possibility of emulsions forming in the oiling system. Moisture in the oiling system is a common cause of trouble, while alkaline water coming over from the boiler with the steam likewise may cause emulsification.

THE author, who has had years of experience in the manufacture and use of petroleum products, and who has written nearly two hundred technical and semi-technical articles in this field, speaks with authority in this simple discussion of an involved and important subject.

It is a practical impossibility to keep water out of a turbine oiling system. Among the means by which water enters the lubrication system may be mentioned steam and water leaks and condensation from moist air. However, if the oiling system has been properly designed and is of ample capacity and *when a suitable oil is used* —note this especially— all the entrained water will separate from the oil in the reservoir and may be drained off.

It is unfortunate that, in many instances, the capacity of the oiling system on a steam turbine is smaller than it should be. Under such conditions, in order that the bearings may receive sufficient oil to maintain the lubricating film, it becomes necessary to circulate the oil at a high rate, frequently so rapid that there is not time for the moisture and sediment to settle out. In such systems it is a common occurrence to find the oil always milky or opaque, as a result of the contained moisture.

When it has been definitely established that the oil used is of the highest quality from a non-emulsifying point of view, and the blame for trouble cannot be placed upon the oil, then the recommended remedy consists either in increasing the capacity of the system and reducing the rate of oil flow, or providing a heater and settling tank to allow the oil more time to settle at reduced viscosity before going to the filter and cooler. Under all conditions every effort should be made to stop the steam and water leaks as far as possible.

The great dread of all power-plant operating engineers is the formation of sludge in the lubricating system. Steam-turbine oiling systems are inclosed and, hence, there is little opportunity for much foreign matter to enter the system, although, naturally, some will be introduced. However, as previously mentioned, there is always the possibility of moisture getting into the oil and causing trouble. As a result the formation of sludges and deposits is not uncommon in many turbine oiling systems that have not been properly designed for removing moisture.

Just as frequent a cause of sludge formation is the use of an improperly refined oil that emulsifies readily or of one not intended for a steam turbine. The continued agitation of the oil and the entrapped water first forms emulsions. Then the oil gradually thickens and picks up and holds any foreign particles that may be in the system. Such foreign matter thereupon acts as an abrasive when the oil is supplied to the bearings. Next, as the oil becomes thicker and thicker, it finally reaches a point where it will not flow properly through the oil pipes and bearing grooves. As a result, bearings that do not receive proper lubrication become hot and wear. So, too, the emulsions and resulting deposit are likely to choke up the governor

great, making its operation unreliable or impossible.

When turbine oils of incorrect grade or poor quality break down under the heat and pressure existing in the lubrication system, the oil-insoluble deposit that forms consists of tarry and asphaltic materials and other insoluble matter. This sludge adheres to all surfaces, obstructs passages and channels and reduces both the lubricating properties and the cooling effect of the oil.

True enough, the sludge usually settles out in the settling tank or is filtered out by the filters. However, if there are any pockets in the lubricating lines, deposits are likely to settle there——more especially so if the settling or filtering units are not efficiently operated. A particular point of danger is in the small passages and pipes in the governor mechanism. If the flow of oil here is resisted or stopped by deposits, there is likely to be serious interference with the governor mechanism. If the oil pumps are always run at the same speed and if no large amounts of new oil are added, this settling of the gummy products will not do much harm provided the whole system is cleaned at regular intervals. But if, for any reason, the pumps are speeded up or *an oil of a different character* is added to the system, this gummy deposit may become dislodged or dissolved from the point where it was attached and cause considerable trouble.

Sludges form more quickly when a readily emulsifiable oil is used. When emulsification is prevented, sludge formation is greatly reduced. There are few oils that are non-emulsifying in the literal sense of the word; however, some oils deteriorate in use much faster than others. The first indication that an oil has started to break down is usually shown either by the formation of a thick, slimy deposit in the strainers and filters or by an increase of temperature in the bearings. When sludging begins, it is better to remove a little oil at a time, using it for other purposes and replacing with fresh oil; or, if the oil seems to be all right otherwise, the batch may be removed and returned after cleaning.

Determining Emulsifying Tendency of Oils

From the foregoing discussion it should be clear why it is advisable to know before an oil is used in a steam-turbine the rapidity with which the oil will separate from water, this, in turn, in many cases giving an indication as to how rapidly the oil will form sludge deposits.

It is self-evident that in most instances service tests are impracticable because of the time and expense involved. So, too, oxidation tests, while they give information concerning the sludge-forming tendencies of the oil, are not quickly made and even when made tell nothing concerning the rate at which the oil will separate from water.

Several emulsification tests are in common use: (1) A.S.T.M. Steam-Emulsion Number; (2) U. S. Government Emulsion Test at 130 deg. F.; (3) U. S. Government Emulsion Test at 180 deg. F.; (4) U. S. Government Demulsibility Test at 130 deg. F.; and (5) U. S. Government Demulsibility Test at 180 deg. F.

The method of determining the A.S.T.M. Steam-Emulsion number is described in publications of the American Society for Testing Materials; the U. S. Government Emulsion and Demulsibility Tests, in Bureau of Mines Technical Paper 323 B.

A simple, practical method of comparing the non-emulsifying or separating qualities of two oils is as follows: Place equal quantities of oil and water in each of two 4-oz. bottles. Have both samples at the same temperature and then agitate them (by hand shaking, if no other means is available) in a similar manner and for the same length of time. Note how rapidly the oil and water separate. This will give an idea as to the relative emulsifying qualities of the two oils. The number of times the agitation and separation are repeated often influences the results. On a first test one oil might separate more rapidly than another, whereas on, say, an eighth test, the first oil might fail to separate completely, while the second might separate well even though slowly. Generally speaking, the viscosity of the oil affects the rate of separation, heavy oils ordinarily separating much more slowly than light oils.

A demulsibility test is of the utmost importance in determining the suitability of an oil for steam-turbine lubrication. For this reason it is important that the purchaser of turbine oils include specifications for demulsibility in all purchasing specifications.

Government specifications for demulsibility on turbine oils are as follows: When the emulsion test at 130 deg. F. is made on extra-light, light and medium grades of turbine oils, the oil should separate in 30 minutes from an emulsion with normal caustic-soda solution, while the upper layer at the end of 30 minutes should not contain more than 10 per cent of water. For heavy and extra-heavy grades of oil the emulsion test is made at 180 deg. F., but the specifications remain the same. In these specifications the word "separate" is interpreted to mean that there should be only a slight cuff (that is, no continuous layer of emulsion) between the water and the oil.

Effect of Bearing Temperatures

The temperature of a bearing in a steam turbine, regardless of the cause, has a number of effects upon the turbine oil, one of the most important of which is the effect upon the viscosity or body of the oil.

All oils become more fluid (that is, decrease in viscosity) with an increase in temperature; conversely, they become thicker (that is, more viscous) as the temperature decreases. If most efficient lubrication is to be attained, it is essential to consider the viscosity of the oil at the normal operating temperature. Since operating conditions vary with almost every turbine, in selecting a turbine oil it is good practice to refer to curves showing the viscosity of that oil at various temperatures.

Should it be desirable to decrease the bearing temperature, this can be done by using oil of lighter body; that is, lower viscosity. On the other hand, if bearing clearances are great or bearings are rough, or other unusual mechanical conditions prevail, then a heavier oil than usual can often be used to advantage. Under such conditions the use of lighter-bodied oils might lead to trouble, in view of the fact that the oil would not have sufficient film thickness to keep the high points of the surfaces apart. The difference in the mechanical efficiency of the turbine between the use of a heavy and a light oil on a machine with two to six bearings is very small.

If a turbine oiling system is tight, ordinarily there will be little loss of oil and the initial charge will last for a long time. Under normal conditions the oil is heated to temperatures ranging around 140 to 150 deg. F.; under abnormal conditions, its temperature may reach 180 to 190 deg. F. The greatest effect of high-bearing temperatures on turbine oil is a slow decomposition and slight oxidation of the oil. All petroleum oils when subject to high temperatures, and especially in the presence of air, slowly change their composition. Un-

desirable compounds that are likely to cause gumming and emulsification tend to form. Under extreme conditions and especially in the presence of water, a slight corrosion of the metal surfaces may occur. Evidence of a slow decomposition is usually manifested by a darkening of the oil.

The combined loss from friction and heat transmission in the bearings of a turbine is generally estimated at about one-third of one per cent of the turbine's rated output. Use of a more viscous turbine oil than is actually required to lubricate efficiently only increases this frictional loss since, when a turbine is properly set up and operated, there is no solid or bearing friction. The heating of a bearing is due entirely to the "fluid friction" of the oil, and to the heat radiated and conducted to the bearing from the journal and other metal parts.

Use of Oil Colors

The quantity of oil present in a turbine circulating system should be from 0.15 gal. per kw. for small turbines to 0.10 gal. per kw. for the largest units. However, for most efficient results the minimum quantity of oil in any circulating system should be around 120 gal. The oil pump should deliver a supply at the pressure required, equaling 0.05 to 0.15 gal. per min. per square inch of total projected bearing surface. Where the oil pump is an integral part of the turbine and there is no automatic provision for oil supply at reduced speeds, it is necessary that the bearings be flushed continually by an auxiliary pump until the turbine has reached a speed of 20 to 25 per cent of the normal.

If an oil cooler is found to be too small in capacity, little advantage, if any, results from increasing the flow of cooling water through the cooler; the only real remedy is to increase the capacity of the cooler by adding more surface. Thin, twisted metal strips (called retarders) of the same kind of metal used in the making the tube are often placed in the tubes in an effort to break up the flow of the oil. Since the average rate of oil flow through a cooler is one to two feet per second, naturally the oil shoots through without being broken up. The total cooling surface of an oil cooler in square feet may be taken as being two or three times the quantity of oil in gallons circulated per minute. With tubes of very small bore or where the tubes are fitted with retarders, the lower figure may be used. Great advantage is claimed for flattened oil-cooler tubes over ordinary tubes with an increase in heat transmission from between 70 and 200 B.t.u. per sq.ft. per deg. F. per hour to between 370 and 490.

Specific Examples of Turbine Lubrication Troubles

With the thought in mind that one learns most readily by the use of typical examples, the following instances are given to illustrate the kinds of trouble that are likely to occur in turbine or forced-feed lubrication systems. Some of these examples also show how the emulsion test served to solve the problem in hand, when it was believed that the quality of the oil being used was at fault.

1. In a turbine that had previously operated without any lubrication difficulties, trouble suddenly began. An emulsified sludge had formed throughout the oiling system and the bearing temperatures had increased. It was found necessary to change the oil every three or four weeks, whereas previously the oil was removed only about every six months. Further, as a result of the higher temperatures that had prevailed for months, a large amount of sludge had settled in the oil cooler and had gradually baked into a fairly hard deposit that had almost choked the cooler. Investigation disclosed that the water supply had been changed, and an emulsification test with fresh oil using this water showed unsatisfactory separation of oil from water. This explained the cause of the trouble.

2. In another turbine installation the oil coolers were constantly filling up with a thick, slimy deposit. An emulsification test made on a sample of new oil with fresh water showed a good separation. Upon further investigation it was found that the boilers were priming and contaminating the oil with boiler salts, which caused the formation of the sludge.

3. In a somewhat similar case, where a tenacious, emulsified sludge had developed in the oiling system of a new turbine, it was found that the oil was contaminated with soda which originated in the water-softening plant.

4. In still another installation a black deposit had developed throughout the system, settling particularly in the oil cooler and in the oil inlets to the bearings; also in the governor, where it prevented proper functioning. Upon examination it was found that in this case the trouble was due to an insufficient amount of oil in circulation. The temperature of the oil became too high, and the oil was quickly oxidized.

Leakage of fatty or compounded oil into a forced-feed lubrication system will soon cause emulsification and sludging troubles. This is especially true on ships, where great care must be exercised to prevent contamination with marine-engine oils, as such oils are usually compounded with rapeseed oil.

In conclusion, then, it can well be emphasized that efficient steam-turbine lubrication depends (1) upon the selection of a high-quality oil *of the proper grade* and (2) upon regular inspection and testing to see that the quality of the oil is remaining uniform. Tests for demulsibility and acidity are probably the most important tests that should be made on used oil. A determination of viscosity is generally less important in checking the quality of the oil in use, since in the majority of cases it has been found that use has but little effect upon the viscosity of a turbine oil.

The Controller Part of the Motor

A fact frequently overlooked in motor applications is that the selection of the controller is equal in importance to the motor. Probably as many motor applications have been unsatisfactory on account of using a controller not suited to the drive as because of selecting the wrong type of motor. The controller, in a sense, is a part of the motor and contributes its quota to making the drive a success or failure, depending on the intelligence put into its selection. In the next issue the article, "Selection of Controllers for Direct-Current Motors," discusses this problem from many angles and gives suggestions for choosing control equipment to suit the motor.

Power in South America

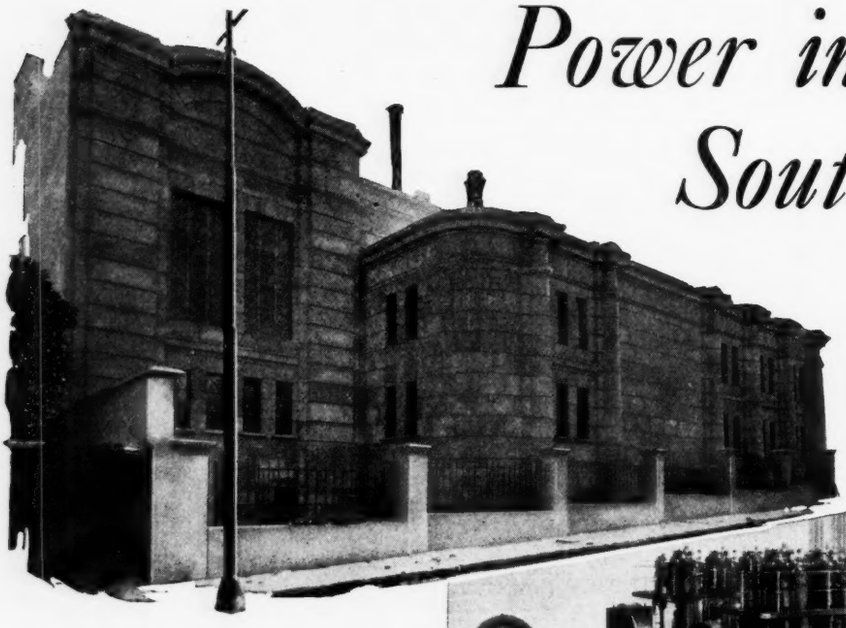


Fig. 1—The Concordia Argentine power plant

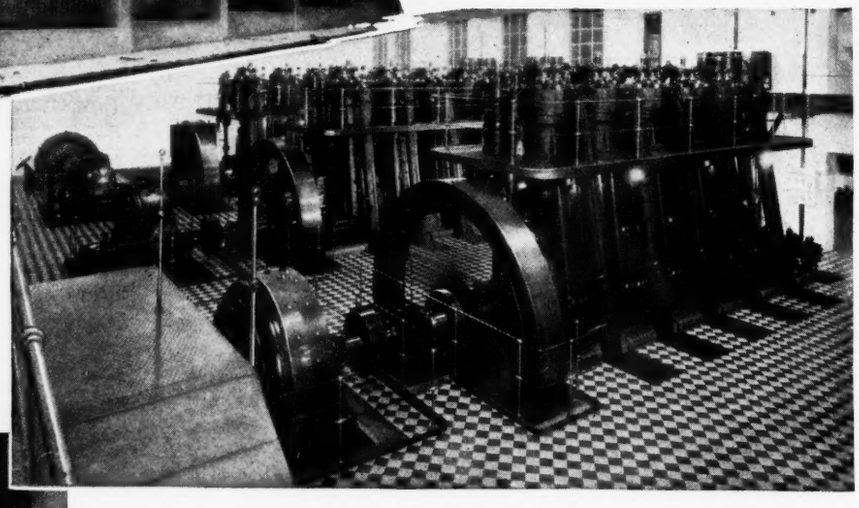


Fig. 2 (Right)—The plant contains three 780-hp. Diesels

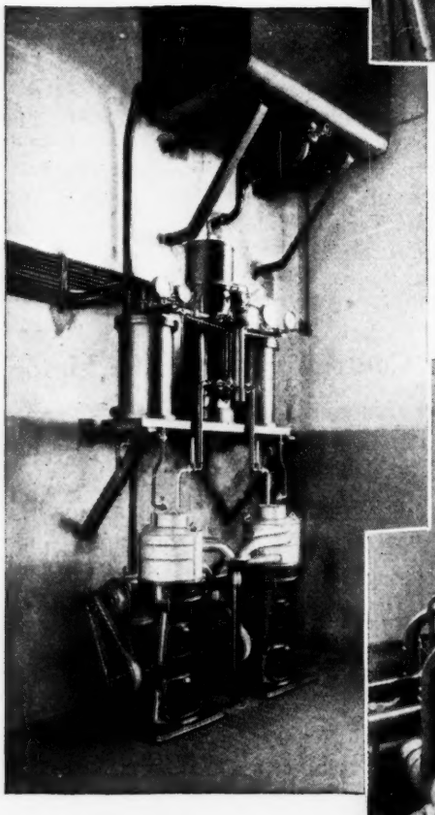
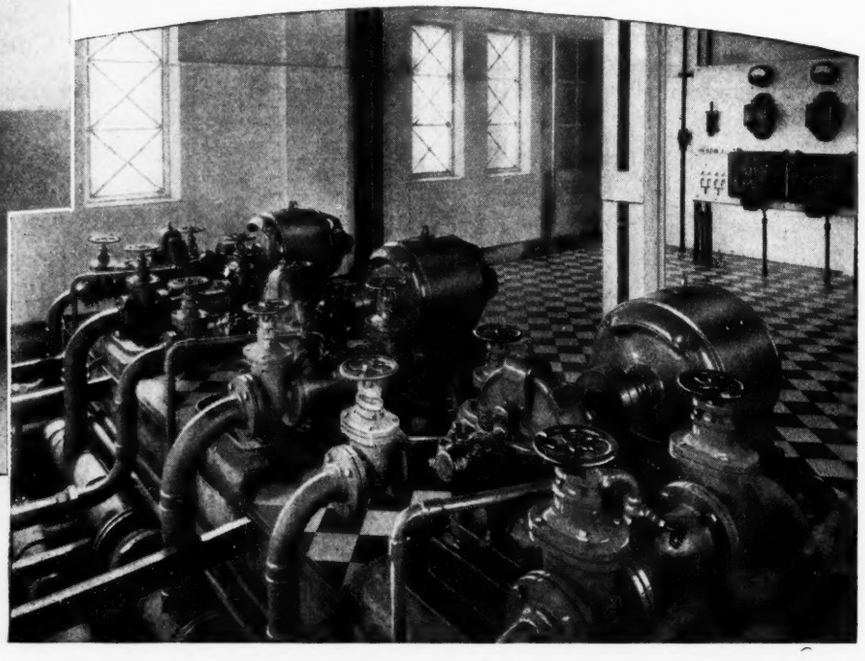
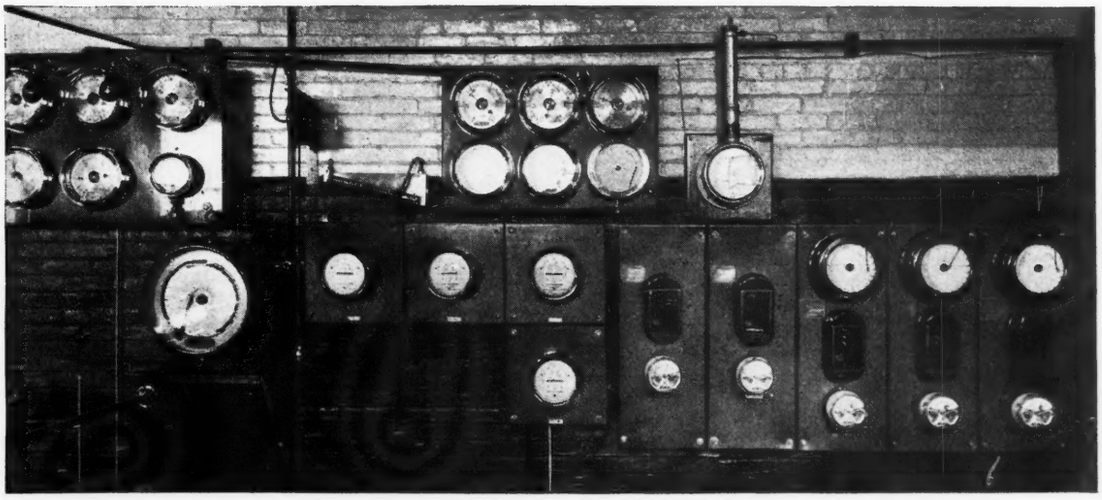


Fig. 3 (Left)—The oil centrifuges are neatly installed

Fig. 4 (Below)—Cameron centrifugal cooling-water pump





Installation of instruments which prevents power wastes in industrial plant

Using METERS *to Prevent Power Waste*

By W. S. Everham

Chief Engineer, Norwich Pharmacal Company
Norwich, N. Y.

While a modern central station has all kinds of apparatus to aid in the economical production of power, the industrial plant often does not know how much steam it produces per pound of fuel burned or what it costs to generate a kilowatt-hour. The cost of the steam and power used to make a product should be as definitely known as the cost of the other elements entering into its manufacture. This means that the industrial plant should be equipped with appliances for making such determinations.

Steam is much easier to waste than electricity, and without records to show where it goes, one cannot prove that the plant is being operated efficiently. Too many manufacturers consider their power plants as necessary evils and do not know what they derive from them. The engineer should seize every favorable opportunity to urge the installation of apparatus to protect his reputation for efficiency.

The Norwich Pharmacal Company, Norwich, N. Y., uses a large amount of steam in its processes. Realizing that steam was being wasted, this company equipped its boilers with integrating and recording steam-flow meters to determine the amount of steam being produced. All coal is weighed, so the pounds of steam produced per pound of coal is known.

The boilers are also equipped with indicating and recording CO_2 meters and recording thermometers. This makes possible a check on the firing.

The installation of the steam-flow meters resulted in a saving of 12 per cent of the coal formerly burned and 3 per cent of the labor. The whole operation of the plant was also speeded up and improved. The installation of pulverized-fuel equipment is now being planned as a further advance.

All steam used in manufacturing is also metered. This gives a record of steam used in manufacturing. In turn, the departments using steam are also metered. A record is kept, which is turned in to the cost department in order that this expense may be included in the cost of production along with the other items. These meters also give a check as to any leaks that may occur while the plant is shut down, as they are read at the beginning and end of each day. Thus steam recorded during the shutdown period means a leak which otherwise might not be discovered for some time.

By comparing corresponding departmental outputs and amounts of steam used, a check is obtained on the cost of production. This has resulted in a great saving in the use of fuel.

Steam is also used in the generation of electricity and operation of auxiliaries, compressors and pumps. Engines are indicated, giving the amount of steam used for generation and hence the steam cost per kilowatt-hour. The exhaust from the engines and auxiliaries is used for heating buildings, driers and other apparatus. Credit is given the generators and auxiliaries for this heating steam, thus reducing the cost of electricity and other services. When the plant is not in operation, and it operates only nine hours a day, live steam is used through a reducing valve for heating. This steam is

also metered. All condensate is returned to an open heater supplying the boiler feed. Every precaution is taken to avoid the waste of heat units.

Distribution of electric power is done on the same basis as distribution of steam. Record is kept of its use by the different departments. Thus the cost of current is known for a given operation or group of operations, and one department is not unjustly penalized while another holds an unfair advantage.

Daily records are kept of all important quantities necessary for a complete comparison of operating costs. These records are so prepared that month may be compared with month and fiscal period with fiscal period. Thus at all times it is possible to check waste and fix responsibility where necessary, which goes a long way to bring about maximum plant efficiency.

The thing for the industrial plant engineer to do, therefore, is to give his employers full analysis of plant conditions, so that economy may be increased, not only in the power house, but in the plant in general, and methods of producing and handling the products be improved.

Deposits in Turbines Cause Inefficiency and Breakdown

By W. E. Warner
Brentford, England

It is of the greatest importance that the steam supplied to turbines be clean and free from impurities. If the boiler frequently primes, or there is a high concentration of impurities or a boiler compound is used to soften the water in the boiler, impurities will be carried into the turbine.

In the first stages these impurities will be carried forward with the steam and erode the blading, but in the later stages, where the steam becomes more moist, they will tend to settle on the blades as a paste, which dries when the turbine is shut down, so that in time a layer of deposit collects on the blades. This deposit increases the weight of the blade, upsets the balance and may cause vibration, which will be most pronounced in the last stages where the bulk of the deposit collects.

The deposit may easily lead to blade vibration. It also increases the centrifugal stress on the blades. The steam passageways may become partly choked up and this may cause unevenness in the steam supply. Pulsations due to uneven blocking may be an additional cause of blade vibration. Moreover, choked passageways reduce the efficiency of the turbine by increasing the pressure drop. Deposits also collect at the bottom of the casing where they are usually harmless unless too much accumulates.

In one instance a turbine gave considerable trouble due to deposits. When it was opened up for cleaning a sample of the deposit was analyzed. It was found to consist of 4 per cent iron oxide, 70 per cent calcium sulphate, 13 per cent calcium carbonate, 9 per cent magnesium carbonate, 4 per cent insoluble matter and a trace of copper.

The weight of deposited material taken from each blade was estimated as closely as possible and the increased stress due to this deposit was calculated as follows:

Centrifugal force on clean blade 121.2 lb. Centrifugal force on clean blade with deposit present 153.7 lb. Stress due to centrifugal force on clean blade 6,730 lb. per sq.in. Stress due to centrifugal force on blade with deposit, 8,540 lb. per sq.in. Increase of stress due to deposit = 26.8 per cent.

This shows how great an increase in stress may be caused by such deposits; an increase of 26.8 per cent would be quite sufficient in many cases to lead to a breakdown. Serious vibration would result in any case. In this particular instance no damage was done beyond stripping a few blades and fracturing an oil pipe, which resulted in the waste of some forty gallons of oil and forced a shutdown.

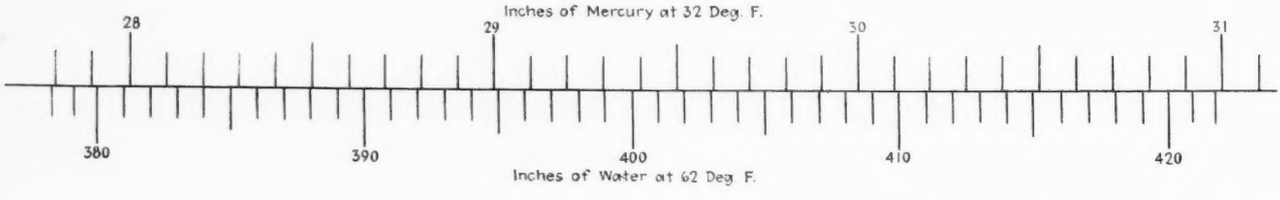
It was necessary to open up the turbine every ten weeks for cleaning. This was finally remedied by installing an efficient softening plant which reduced the concentration of impurities in the boiler water, the water having originally contained 42.5 grains per gallon of suspended matter, largely calcium carbonate and magnesium carbonate. A system purifier was also fitted to clean the steam before it passed into the turbine.

The writer is familiar with other cases of trouble due to the formation of these deposits. In one case it was necessary to open up a turbine every six weeks for cleaning because deposits formed so rapidly. In less severe cases efficiency is reduced, while unbalance increases the liability to breakdown.

All this can be avoided by supplying the steam as clean as possible. A principal cause of impurities getting into the boiler and then being carried over into the turbine is an overworked water softening plant, if this is too small for its work the reactions will not be completed in the softener and some of the chemicals will be carried over, thereby increasing the boiler-water concentration.

Inches of Mercury and Inches of Water

Since pressures are often measured by manometers using water or mercury for the working fluid, these conversion scales may be convenient. They cover the range of variation usually met with in atmospheric pressure near the sea level, and should prove useful in studying draft observations.



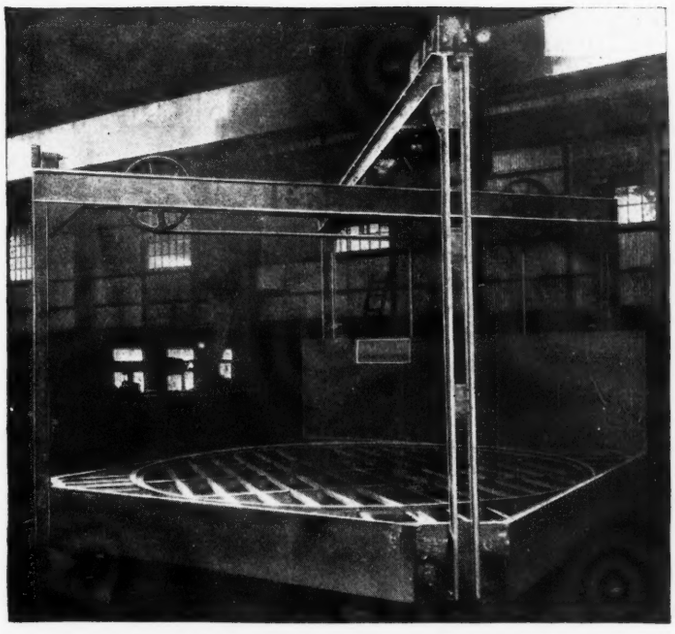


Fig. 1—Car frame before the turntable had been installed

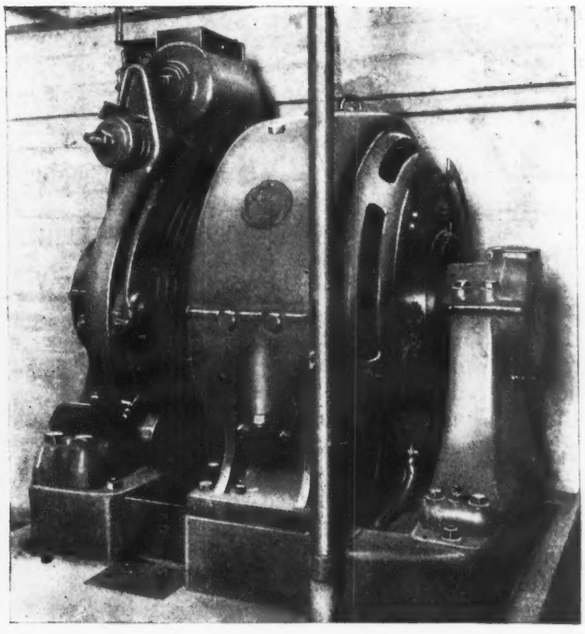


Fig. 2—Hoist motors run at 65 r.p.m. and develop 65 hp.

HEAVY-DUTY ELEVATORS

Level Automatically

By C. E. Spaulding

General Electric Company, Los Angeles, Calif.

A UNIQUE elevator system which increases the capacity of the building by allowing the storage of one car per 169 sq.ft. gross area, has been installed in the Hill Garage, Los Angeles. Three elevators are provided, spaced 50 ft. apart at one side of the building, which is 13 stories high. Doors are provided on three sides of the elevators, and by means of turntables automobiles are stored on three sides of the elevators without devoting a large amount of space to aisles. Each elevator's platform is 21 ft. square, equipped with a turntable 20 ft. in diameter. The turntables are electrically operated and under push-button control convenient to the operator in the car.

Automobiles are discharged on three sides of the elevator and the openings are equipped with automatic, vertical, sliding, center-divided, counterbalanced fire-doors. These doors are arranged to operate simultaneously by means of electrical equipment in the penthouse. The door mechanism is push-button operated and is under the control of the elevator operator. The elevators are operated by gearless traction motors with two to one roping, variable-voltage control being used, and operate at a speed of 300 ft. per min. They are equipped with General Electric automatic leveling devices and are designed for a normal load of 8,000 pounds at rated speed.

The car platforms are so large (21 ft. square) that the weight of the elevator itself is heavy for the amount of load to be carried. The combined weight of car and turntable is 26,000 lb. This, together with the live load of 8,000 lb. makes a total of 34,000 lb. to be moved. Such an unusually heavy load carried directly by the hoist motor would make it necessary to increase its dimensions and the bearings to an uneconomical and prohibitive degree.

Each car, therefore, is counterweighted independently of the machine counterweight. Introducing a car counterweight not only simplifies the driving-motor load problem, but also reduces the problem of providing a safety device on the car for the total load to be carried. Counterbalancing part of the car weight independently causes some loss of traction, and this independent counterweight is kept low enough to allow sufficient weight on the machine counterweights to maintain a safe margin of traction from no load to full load. Variable-voltage control provides for a lower margin in the amount of traction necessary to be maintained on account of the smoothness that will characterize retardation.

Fig. 3 shows the general arrangement of roping up the machine. The ends of the hoist cables are dead-ended in the overhead work. From one of these dead ends the hoist cables pass under two sheaves in the main crosshead of the car, then over the traction sheave of the elevator machine, around under the sheave in the machine's

counterweight and to the other dead end. This is a two-to-one roping and the car travels at one-half the speed of the cables. The cables for the car counterweights are attached to the auxiliary crosshead of the car and passed over the overhead sheaves to the car counterweights. This arrangement gives the effect of lifting the car from near the four corners and is effective in distributing the strains in the car's framework.

Because entrances to the elevators are on three sides of the platform, the elevator guide rails are placed at the corners of the platform. On account of the size of the platform two car frames are used, one between the guide rails and the other to support the unguided corners of the platform. The turntable is mounted on the car frame and arranged to operate on tapered rollers equipped with roller bearings to reduce friction. This turntable is driven by a 1½-hp., constant-speed, squirrel-cage induction motor.

Two man lifts are provided so that employees can go from floor to floor without interfering with elevator traffic.

After receiving a load from one of the lower floors, the operator closes the elevator doors by pressing a button, after which the car is started by the car switch. The car then goes to whatever floor is designated. During the time that the car is traversing the hatchway, the elevator operator can, if necessary, turn the load by means of the turntable to face the required side of the elevator from which the car is to be discharged. When the elevator approaches the desired floor, the operator throws the car switch off and the automatic leveling equipment brings the car to the floor level, while the operator is opening the doors. In delivering, the operations are reversed.

The hoist motors are of the gearless traction type and, incidentally, are the largest mechanically so far built by the General Electric Company for elevator use. They are rated 65 hp. each and operate at a speed of 65 r.p.m. Three 60-hp. motor-generator sets with the necessary control panels complete the equipment needed to operate the hoist motors. In order to minimize static friction, precision roller bearings are used in all sheaves. There is a passageway under the elevators, and the counterweights are, therefore, equipped with a safety device similar to that on the cars. A special safety device is provided to stop the car and counterweights with a smooth and gradual stop within fifteen feet. The guides for the car will weigh 30 lb. per ft., and those for the counterweight, fifteen lb. per foot, being sufficiently heavy to take care of the strains due to large car and counterweights and the movement of heavy loads on the cars.

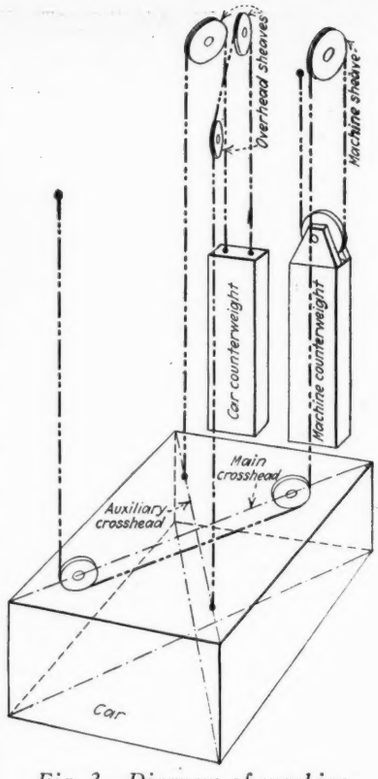


Fig. 3—Diagram of machine roping

Kenneth MacDonald, Jr. & Company are the architects, and the Baker Iron Works, Los Angeles, Calif., built and installed the elevators and guides.

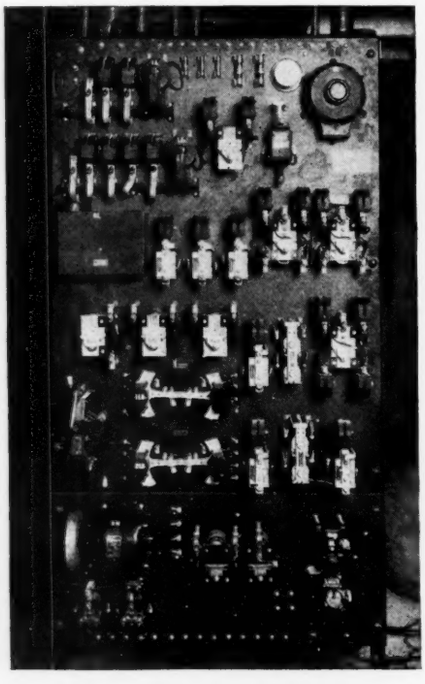


Fig. 4—One of the hoist-motors controllers

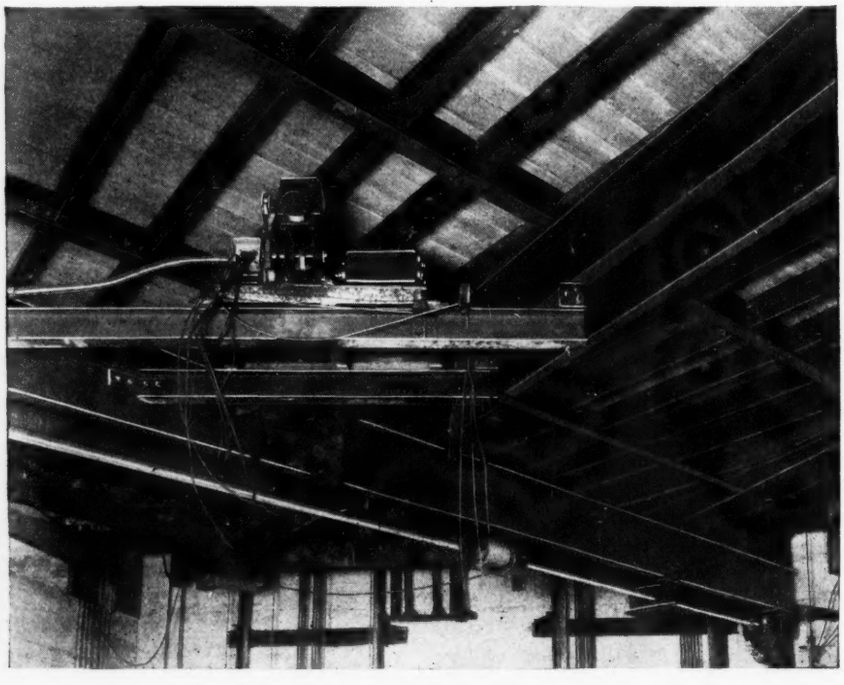


Fig. 5—Underside of the car, which with the turntable, weighs 26,000 pounds

On approaching a floor where the car is to stop, the operator centers the car switch and the car is stopped automatically, level with the floor. On the underside of the car, Fig. 5, can be seen the equipment for operating the turntable on the car. This turntable may be operated when the car is in motion. The hoistway doors are operated electrically and are under the control of the operator from a push button in the car.

THE CENTRIFUGAL PUMP

Its Operation and Characteristics

By M. Spillman

Consulting Engineer,
Worthington Pump & Machinery Corporation

REDUCED to a simple form, the centrifugal pump consists (see Fig. 1) of a rotating chamber, the impeller (2), a pipe directing the water to it, the suction lead (1), a spiral casing (3) to carry off the water discharged from the rotating impeller, a stuffing box (5) and the driving shaft (4) on which the impeller is mounted.

If the pump is placed above a suction level under atmospheric pressure the rotation of the impeller at a predetermined speed would not be sufficient to exhaust any appreciable quantity of air out of the suction pipe, and the water would not be induced to rise therein. A vacuum must therefore first be created by exhausting some air by means of a steam ejector, or a vacuum pump, connected preferably to the highest point of the casing. For ordinary installations the priming apparatus should do its task in two to three minutes. For a proper selection one should specify the static suction lift, the cubic feet of free air in the suction pipe and pump up to the discharge gate valve, and the priming time.

Last week the author discussed the piping system of which the pump forms a part. In this second and final article he discusses what happens inside the pump.

After the valve in the discharge has been closed and the vacuum pump or ejector has been started, the pump is ready to start as soon as the water has risen sufficiently to cover at least the impeller inlet, which can be seen by watching the vacuum gage.

Now the operator can start the pump, shut down the priming apparatus and open the discharge gate valve. The rotating impeller will force the water to flow outward approximately in the direction of rotation toward the spiral casing and from there into the discharge pipe. Water will follow through the suction to take the place of what has moved out.

Characteristic Curves

It can be determined experimentally that the rate of flow through a single system increases as the pump is speeded up. Assuming a variable-speed calibrated prime mover, a venturi meter for measuring capacity, pressure gages at the suction and discharge opening of the pump to give the total head, a series of tests can then be conducted.

With observations begun when the speed, and therefore the capacity, are as high as practical and with gradually reducing speed, at first the capacity will decrease slowly, later more rapidly until a speed is reached where the flow stops suddenly. Evidently, not enough pressure is created then to overcome the static head and the pipe friction of the system. If the observations are recorded graphically, characteristic curves are obtained, based on a constant orifice and variable speed. These curves, Fig. 2, show all that can be accomplished with the pump in this particular system, the heads prevailing at the various rates of flow, the power consumed and the pump efficiency. It does not show what the pump would do in another system and at other speeds, although these additional data could be accurately arrived at by computation.

It is to be emphasized that the centrifugal pump has a perfectly stable characteristic except for a certain range of flows in certain types of pumps.

This characteristic curve is established by the manufacturer on his shop test. A slightly different procedure is followed there, as a general rule. The speed is kept constant, the head and capacity are allowed to vary by manipulating a throttle valve in the discharge line. Readings are taken of the total head, capacity, brake horsepower and speed. The results, when plotted, give the familiar characteristic curves for constant speed and variable orifice.

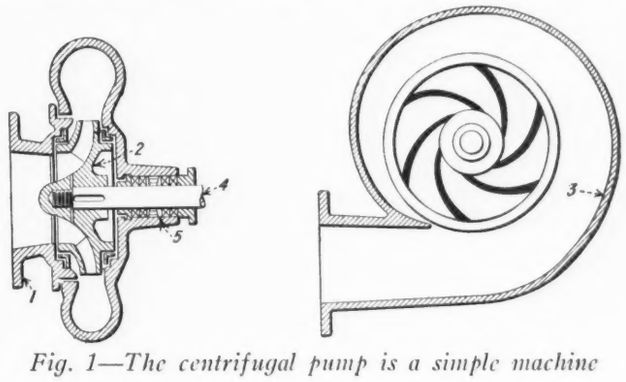


Fig. 1—The centrifugal pump is a simple machine

The slope of these curves is affected principally by the specific speed of the pumps. There are other factors, such as vane angles, number of vanes and casing design,

that will influence the slope, but undue importance is attributed to these latter in the textbooks on centrifugal pumps. As a result of a great many tests the author

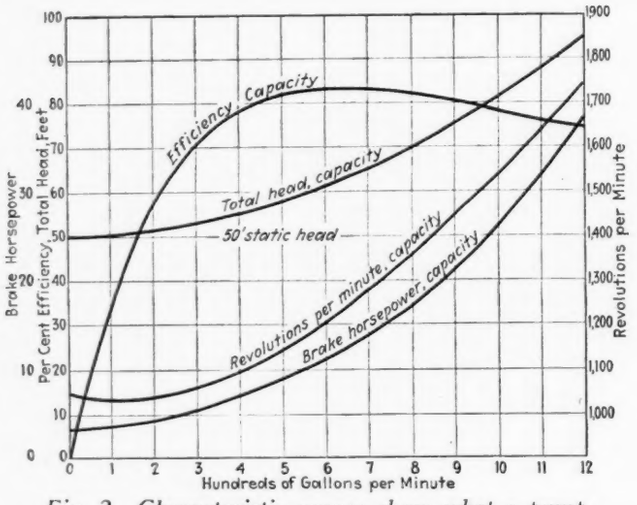


Fig. 2—Characteristic curves show what a pump will do in service

has found that, for any specific speed, only a slight variation can be permitted in the vane angles if maximum efficiency is to be secured.

The user of centrifugal pumps cannot be expected to take undue interest in such definitions as specific speed. However, one cannot avoid referring to it, as it explains many peculiarities of pumps that are sometimes so puzzling. The specific speed of a pump is the r.p.m. of a model, geometrically similar in all respects to the pump in question, of such a size that it will pump one cubic foot per second of water against a total head of one foot. There are other definitions of specific speed in use, using other units of capacity.

The curves of Fig. 3 show constant-speed char-

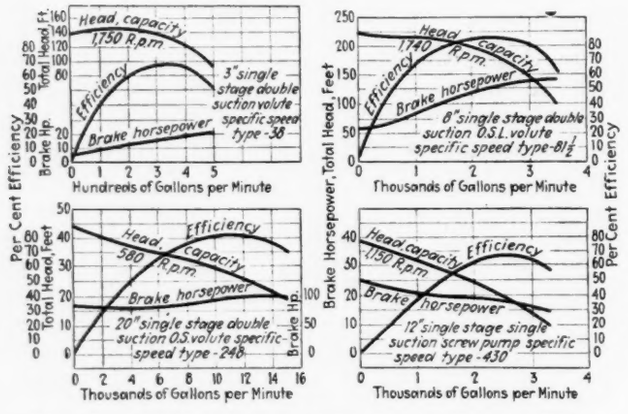


Fig. 3—Specific speed affects pump characteristics greatly

Note that the scales are different for different sets of curves.

acteristic curves plotted from actual shop tests of pumps having specific speeds of 38, 81.5, 248 and 430. An examination of the head-capacity curves shows that they differ greatly in slope. This would become much more apparent if we were to plot and compare them on a 100 per cent basis. There is a quite bewildering variety of curves possible between 38 and 430 specific speed, and this does not even include any extreme types.

This characteristic curve at constant speed, in addition to showing the relation between capacities and heads, will show the possible variation of power to be delivered by the driving motor. The efficiency curve is of partic-

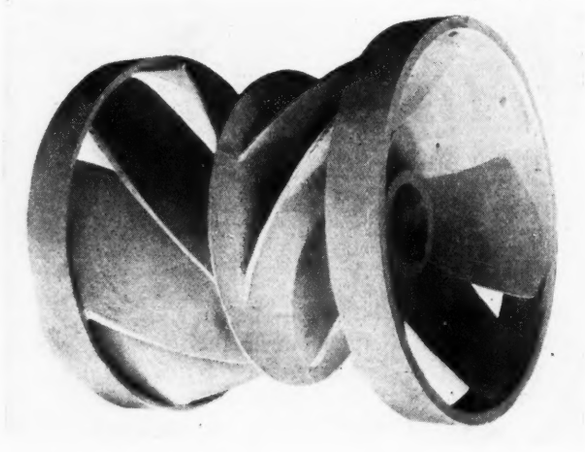


Fig. 4—A pump runner for low-head service

ular interest. Rising from zero at no flow, it follows a more or less parabolic form to reach a maximum and then to drop to zero again at no head. It will be seen that the lower specific-speed types have better efficiency at subnormal flows than the higher specific-speed types.

Type 38, shown in the upper left-hand corner of

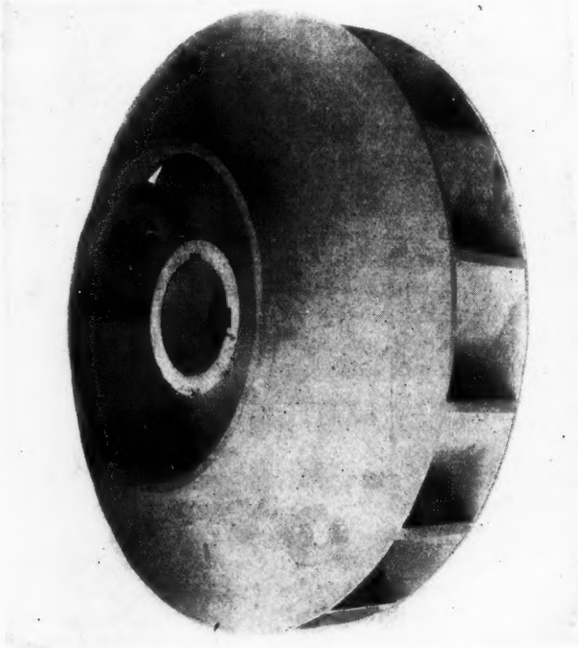


Fig. 5—A typical impeller for low specific speed

Fig. 3, is to be found in the average boiler feed pump. The pump impeller has vanes similar to Fig. 5. Type 81½, in the upper right-hand corner, may represent a general service pump with an exceptionally good performance. Type 248, lower left-hand corner, might be a general service pump for lower heads. If operated at a somewhat reduced speed, it would fit the requirements of the ordinary condenser circulating system.

Fig. 4 shows a representative impeller of this type.

For type 430, in the lower right-hand corner, the curve is plotted from a test of a model of an axial-flow impeller used in so-called screw pumps, a type admirably adapted for condenser circulating pumps for very great capacities. Fig. 6 shows the impeller type.

A normal water level must be maintained in the boiler. In practice there is some variation between a maximum

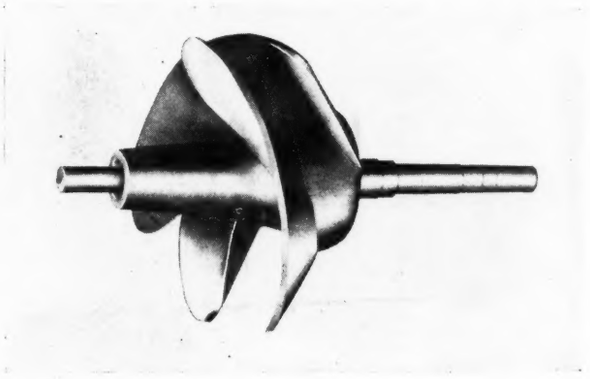


Fig. 6—Impeller for a screw pump

and a minimum. A suitable water-level regulator can limit the flow from the centrifugal pump either by

1. Actuating a throttle valve in the pump discharge line.

2. Actuating a control to vary the speed of the prime mover.

3. By a combination of (1) and (2), excess-pressure regulators, etc.

We shall briefly analyze this control problem by choosing a concrete example at random.

Fig. 7 represents the characteristic curve of the aver-

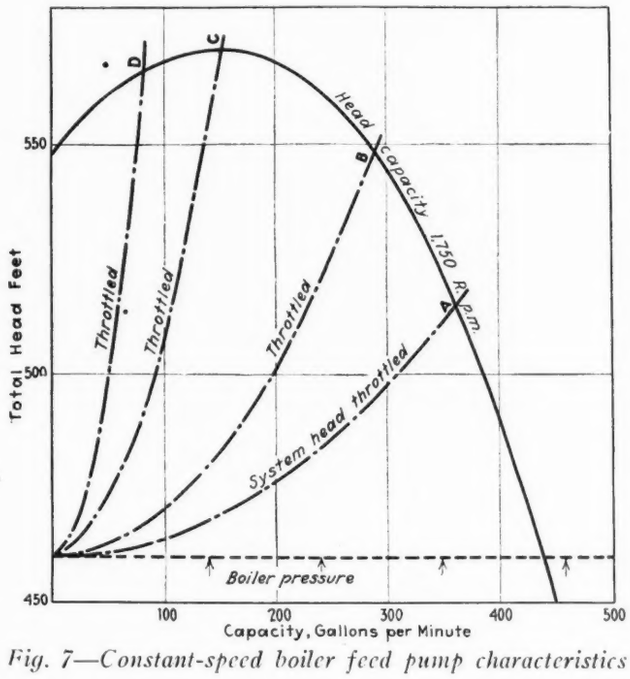


Fig. 7—Constant-speed boiler feed pump characteristics

age boiler feed pump, specific speed type 38. It is a reproduction of a curve from Fig. 3. The pump has four stages to generate 515 ft. head at a flow of 360 g.p.m. The boiler pressure is equivalent to 460 ft. head. The pipe friction and throttle-valve resistance are assumed at 55 ft. with 360 g.p.m. Four throttle positions, *A, B, C, D,* are indicated and it is evident that the pump is perfectly stable at any of the rates of flow selected, for illustration: 360 g.p.m., 515 ft. head; 286 g.p.m., 548 ft. head; 150 g.p.m., 570.5 ft. head; 80 g.p.m., 565 ft. head. The pump shutoff head is higher than the boiler pressure head and the additional throttle head is elastic and does not allow the pump to "get off the line" even after the turning point in the characteristic curve has been reached.

Difficulties would be experienced, however, were we to operate two such pumps in parallel at any head range

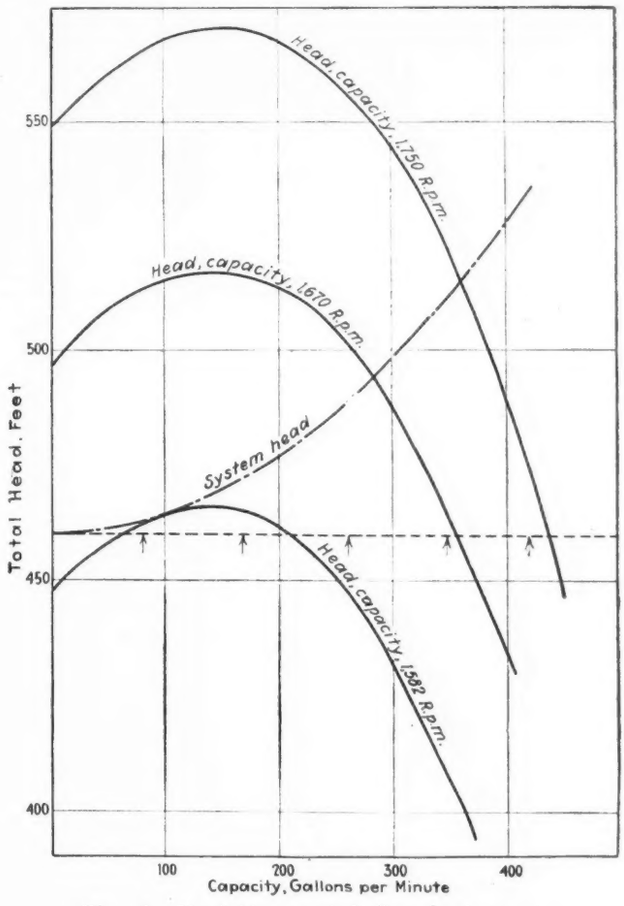


Fig. 8—Variable-speed boiler feed pump characteristics

between 548 ft. and 570½ ft. It might happen, then, that one pump operates at the right and the other pump at the left side of the curve, which slopes down at both sides from the highest head point. The capacity of the two pumps could be then equalized by manual operation of their respective throttle valves. Once the pumps are adjusted, however, they will keep on in equilibrium until another sudden load change may make manual readjustment necessary.

Characteristic curves of the same pump for variable speed are shown in Fig. 8. There will be stable flow until the pump characteristic curve becomes a tangent to the system head. This occurs at 100 g.p.m., 464 ft. head, 1,582 r.p.m. Any attempt to reduce the capacity further by lowering the speed below 1,582 r.p.m. will occasion a sudden cessation of the flow; in fact, flow will be reversed and go from the boiler through the pump. The check valves will now come into action.

We are facing, therefore, operating difficulties at light

loads, with variable-speed drive especially. To retain the power saving resulting from the latter and overcome the surging, we might install in this system a throttle control, to be used only at times of light loads, and limit the speed reduction of the driver so that the shut-off head remains at or near boiler pressure.

Another method is to design the pumps with a steady rising capacity-head curve. This can be obtained by selection of high specific speeds, but requires a greater number of stages than is now customary. To produce such steady rising curves with the ordinary low specific-speed wheel, one must sacrifice a part of the head that can be generated, usually by distorted impeller and casing designs and the pump takes a penalty in considerably lower efficiency. It is advisable to use quick-closing check valves to dampen the water hammer.

Condenser Circulating Pumps

Large capacities and low heads distinguish this system. Quite generally, the water in the discharge basin is at the same elevation as the supply. Practically everything is friction head. Capacity variation is desirable to obtain best vacua in the condenser with the least power.

The flow will then vary directly with the speed of the pump, the total head as the square of the speed, and the power as the third power of the speed. The pump will give nearly constant efficiency at all speeds.

For greater flexibility it is customary to install two circulating pumps and operate them in parallel and at maximum speed in summer, while one pump is shut down and the other run at reduced speed in winter time.

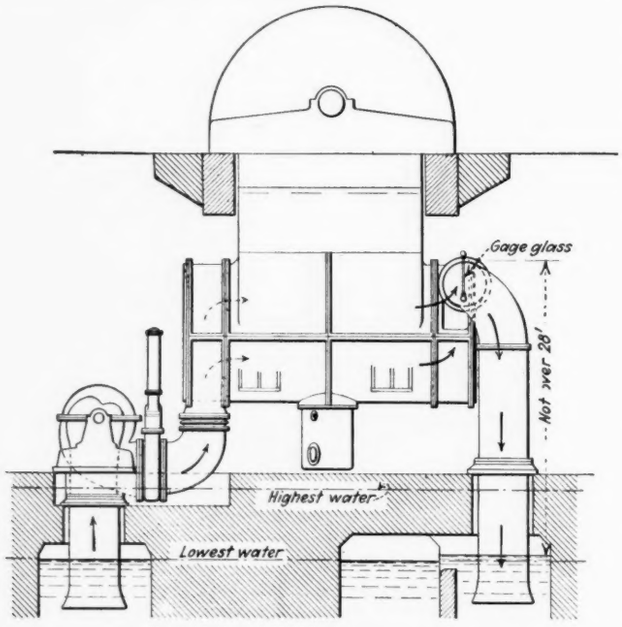


Fig. 9—Typical circulating pump arrangement

Good results can be obtained also with two-speed alternating-current motors. The selection of the pump is made by trying to find a pump characteristic having a high efficiency over the operating range. The pump should be of high specific-speed as the step rising characteristic curve can take care of added resistance with dirty condenser tubes.

Fig. 9 shows a typical layout of condenser and horizontal circulating pumps. Fig. 10 shows an arrangement made possible by the use of a vertical pump. The top of the condenser is set below low-water level. No priming is required for either pump or condenser, and the water pressure being everywhere above atmospheric, there is no liberation of dissolved gas, and consequently this source of tube corrosion is eliminated.

The centrifugal pump is an important piece of power and industrial plant equipment, and the engineer should understand the wide range of characteristics obtainable. He should know what type of pump to select for a given

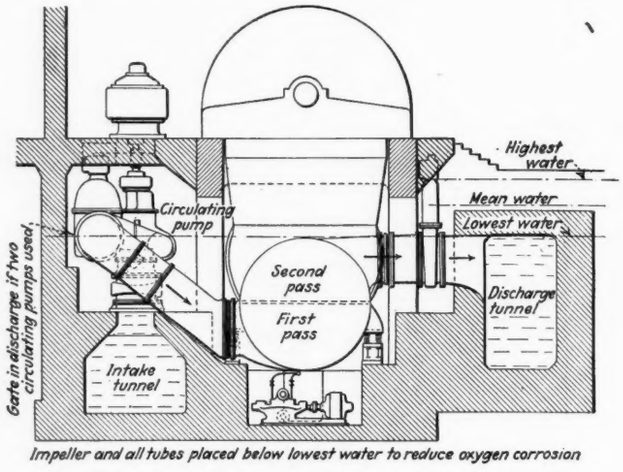


Fig. 10—Vertical circulating pump with submerged condenser

service, and for a given pump should understand its limitations. If pumps fail to give satisfactory service on a particular job it may be for the same reason that a carpenter's brace and bit will not do good work drilling holes in concrete. A centrifugal pump intelligently selected for suitability to its task will prove thoroughly dependable, and if conditions are reasonably constant, its efficiency will be high.

Change in Duct Design Saves 400,000 Kw.-Hr. a Year

A word to the wise is sufficient, but to profit from it is not always easy. Prompted by an editorial in Power, *the chief engineer of the East Peoria Station of the Illinois Electric Power Company found a solution to his draft problem, thus increasing the station capacity by two per cent and saving 400,000 kw.-hr. of auxiliary energy a year. How this engineer realized cheaper power through modern duct design will be told in an article in the next issue.*

Forge-Welded Boiler Drums Used in Europe

By J. M. Brennan

OF PROMINENT importance in the power plant today is the rapid change taking place in boiler design. Of equal importance alongside the desired capacities and efficiencies is the particular manufacturing method employed in making the boiler drums.

Up to the present the riveted seam has been in universal vogue for the low and moderate pressures, and the solid forged type has been used for extra high-pressure boilers.

The reluctance on the part of engineers, boiler manufacturers, owners, operators and insurance companies to adopt some form of welded drums, may soon disappear because of confidence gained in this method or because of the discovery of a reliable weld-exploring apparatus.

Considerable successful experimental and testing work has been done in this country on autogenous-welded boiler drums, while in Europe actual operating experience has been gained in forge-welded drums. The European methods applied to the manufacture of these forge-welded drums may prove of interest.

Method of Manufacture

The drum plates are made from carefully selected materials, and the usual routine followed to insure plates that will in all cases meet the necessary working conditions.

The Thyssen Works, at Mulheim Ruhr, Germany, has rolling mills capable of dealing with ingots weighing 30 tons, and can roll to a width of 14 ft. This width permits the finished plate to be cut from the homogenous center portion of the rolled plate.

The sheared plates are then annealed, after which they are machined on the edges, heated and rolled circular, being then ready for welding.

The welding machines are designed so as to provide correct and uniform heating through the entire thickness of the plate at the seam. This permits a thorough amalgamation of the metal, and if properly done a perfect and homogenous weld results.

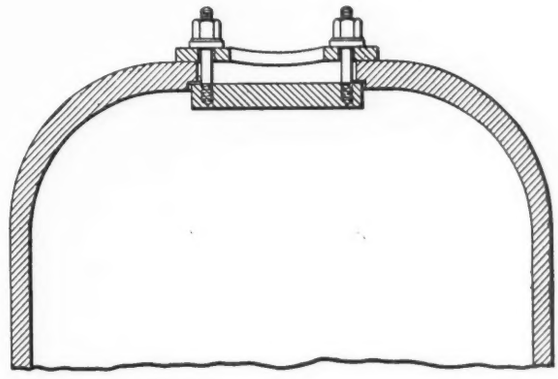
The plate now is in the form of an open-ended drum or tube, and as no further welding is necessary, it is annealed and rolled to true cylindrical form, after which the ends are machined and the drum subjected to a pressure test at 150 per cent of working pressure.

The ends of the cylinder are then heated, and formed hemispherical in large hydraulic presses. This process avoids the necessity of circumferential welds. In this pressing process a hole is left at both ends and the material is considerably thickened, as shown in the figure. This thickening of the metal at the ends of the drum strengthens the manhole seating, and makes additional reinforcement unnecessary.

The drum is then given a hydraulic test at from three to four times the work pressure. Under this severe test the material is stressed approximately up to its elastic limit, and in some parts of the drum this limit may possibly have been exceeded. In order to relieve the effects of overstressing the metal, the drum is annealed in specially constructed furnaces under accurate temperature control.

The heat treatment corrects any change in shape caused during manufacture. It also normalizes the material in respect to any structural changes that might have been produced by fatigue effects, and also relieves internal stresses.

Drums of greater length than those given in the table are manufactured with circumferential welds, which are machine lap-welded in the same manner as the longitudinal weld. The circumferential welds in such cases are placed as far as possible toward the ends of the drum, the maximum distance between two circumferential seams being about 31 feet.



Method of forming drum ends

With the exception of having circumferential welds, these long drums are manufactured and tested in exactly the same way as the drums with the single longitudinal weld.

Summary of Advantages

The advantages claimed for this type of boiler drum, are summarized as follows:

Since the drums are lap-welded, they are therefore free from the inherent defects of riveting, such as compression of material.

The drums are tested to three or four times the working pressure, thus insuring that the welding is thoroughly reliable and that the material is free from defects.

After the pressure tests the heat-treatment eliminates all internal stresses that may have been set up. It also relieves the adverse effects upon the material in the neighborhood of the joint, of any stretching that may have occurred in the process of manufacture. This type of drum provides a component part with smooth interior surface.

The drums can readily be made for any length or pressure. This permits of flexible boiler design, with a construction cost within the limits of practical economics.

DRUM DIMENSIONS IN INCHES

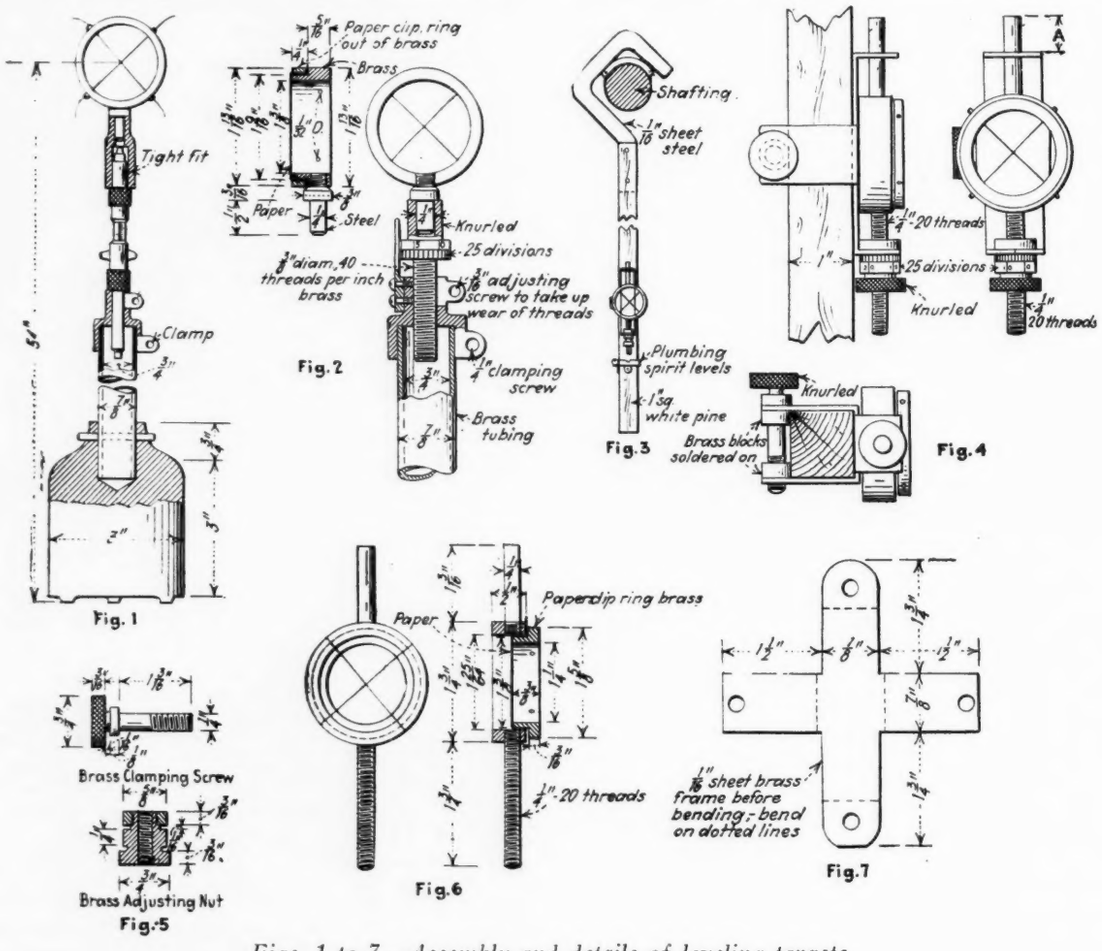
	One Longitudinal Weld											Two Longitudinal Welds							
Outside diameter	25.6	27.5	29.5	31.5	33.5	35.4	37.4	39.4	43.3	47.2	51.2	53.2	43.3	47.2	51.2	53.2	55	59	63	67
Sheet, thickness	1.77	.....	.....	1.97	.....	2.36	2.36	2.36	2.2	2.01	1.81	1.77	2.24 to 2.36	2.05 to 2.36	1.85 to 2.36	1.81 to 2.36	2.36	2.36	2.36	2.36
Over-all length	367	.....	.....	365	.....	364	364	364	363	360	358	357	363	361	358	357	357	355	353	351
Manhole	13.2 x 15	.....	.....	15 x 16.75	.....	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15 x 16.75	15.75 x 17.5	15.75 x 17.5	15.75 x 17.5	17.75 x 19.5

Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY,
IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

Practical Leveling Targets

THE leveling targets that are here described are the result of an instructive article on erecting machinery, by N. L. Rea, that appeared in *Power*, Oct. 13, 1925. Fig. 1 shows the target as ultimately made and fitted with a standard micrometer. Fig. 2 is the target and micrometer attachment that I at first designed, a standard micrometer not being available at the time. It served its purpose well and proved a revelation to the engineers who used it. It was made in a good lathe and proved almost as good as the factory-made micrometer that replaced it.



Figs. 1 to 7—Assembly and details of leveling targets

As Mr. Rea pointed out, the chief merit of this type of target lies in the use of the diagonal cross-hairs. When the horizontal hair in the instrument bisects the diagonal hairs of the target, a small sphere is produced which is distorted by the slightest vertical movement. At a distance of 40 ft. an error of 0.001 in. can be detected.

Holes $\frac{1}{32}$ in. in diameter are drilled in the cross-hair ring, to receive the hairs, which are secured by plugs of white pine. About one-half inch of each end of the hairs project so that they can be pulled tight at any time. The cross-hairs have a background of strong white paper, which is stretched tight and held in place by a brass clip ring.

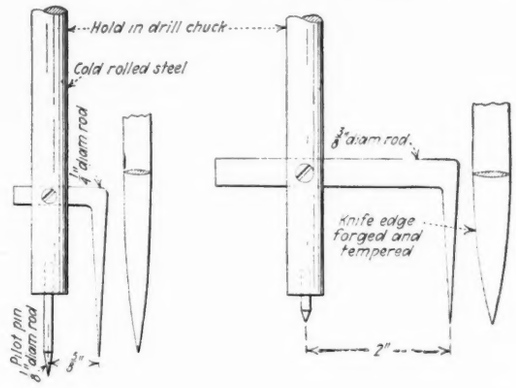
The standard can be of light brass tubing of sufficient length to bring the target to a convenient height. I used a piece of condenser tubing. For leveling sole plates or any flat surfaces, a base of steel, as Fig. 1, is used. It has three blunt contact points. For leveling shafting, a vee-shaped base is used. For leveling ordinary transmission shafting, the target Fig. 3 is useful. It is shown in detail by Figs. 4, 5, 6 and 7. For rough setting the distance *A* Fig. 4 is scaled, and for fine setting the micrometer can be used. The cylinder has 25 divisions, each having a value of 0.002 in.

If the shafting is of one diameter, the target is not moved for the final setting unless the setup of the leveling instrument has to be changed. E. J. JORDAN.

Long Beach, Calif.

Tools for Cutting Gaskets

A SET of tools for cutting out gaskets is shown in the illustration. They are easily and cheaply made and adjustable for varying diameters. When several gaskets of the same diameter are to be cut, these tools will cut through several thicknesses, the procedure being to square out the material and place one atop the other. A board is used to support the material and prevent the



A short tool is used for cutting out the center and a long one for the outside

tools from being damaged by contact with the drill-press table.

The shanks of the tools are made from short pieces of cold-rolled steel and provided with suitable holes for the cutting tools which are locked after adjustment with a setscrew.

The cutting tools are made of round tool steel hand-forged and bent as shown. They are properly tempered after being bent and finished. After the cutter end is forged, it can be finished to shape and brought to a knife-edge before tempering.

A pilot pin made of drill rod pierces the material as the tool is fed down and keeps the inner and outer diameters concentric. The outside circle is cut first. If desired, one tool can be kept for cutting out the hole, while the larger tool is used for cutting the outside.

These tools will give a smooth edge and when kept sharp they will produce a neater job much quicker than cutting out gaskets by hand with a knife.

Syracuse, N. Y. H. L. WHEELER.

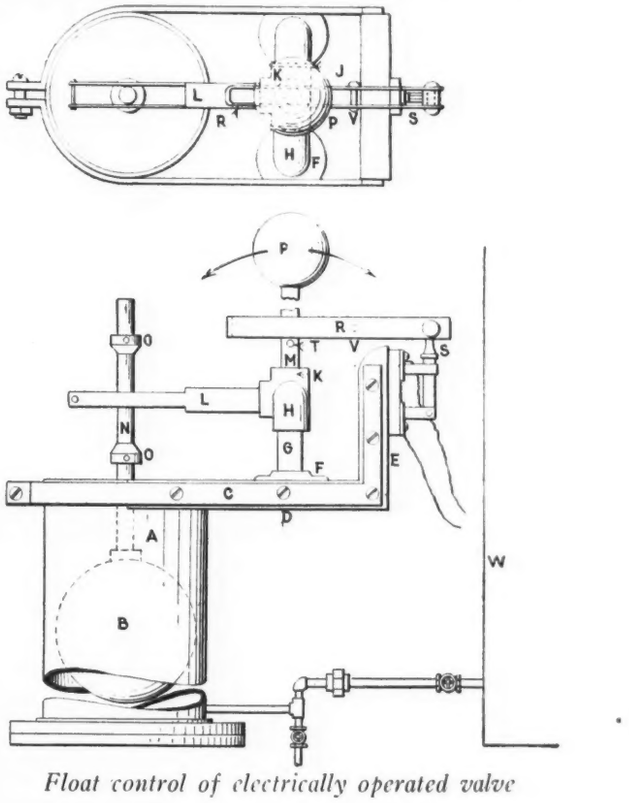
Automatic Control of Water Level in Drinking Water Tank

OUR refrigerated drinking water tank is in the boiler room basement, and about 200 ft. away in another building is the drinking water supply pipe. Between the buildings are tunnels, two banks of electric conduit, pipe tile, etc., and the ground is nicely paved over them. To lay a pipe below frost lines there would be quite an undertaking so it was decided to introduce the makeup water for the drinking supply directly into the return pipe of the circulating system.

Between the buildings was an extra telephone conduit, so we purchased two electromagnetically operated valves and connected them into the system. The wires were drawn through the extra conduit to the power house.

As the water tank was closed and had no room inside for a float, it was necessary to use the modified float-control system shown in the accompanying illustration. The float was placed in a 6-in. pipe 4 ft. long, which was flanged over at the bottom and bolted to a foundation near the water tank W. From the bottom of this receptacle a pipe connection, valved as indicated, was made to the large water tank. In the drawing B represents a float having a vertical stem N with adjustable buttons O spaced as indicated. Around the upper end of receptacle A a clamp C was placed to hold the wooden blocks D and E. To the block D two floor flanges F are attached to support nipples G and elbows H. Between the elbows there is a nipple J carrying a four-way tee K that has been drilled out on the run so that it turns freely. From this tee projects horizontally the nipple L with its outer end slotted as indicated in the drawing. The float stem N passes through this slot. Rising vertically from the four-way tee, nipple M carries the weight P. The nipple M passes through a U-bend bar R made from a brass band which is attached to the handle of the switch S and also is supported by the pin T passing through the brass nipple M.

As indicated in the drawing, the switch is closed so that the electrically operated valve in the other building is open and admitting water to the tank W. As the water level rises, float B will move upward and by means of the lower button O raise the nipple L until the weight P is past the center to the right, when it will fall and by striking pin V in the bar R will open the switch, thus closing the valve and stopping the flow of water to the tank.



Float control of electrically operated valve

As the water level falls, the float B will drop, bringing the upper button O down upon the level L until the weight P passes the center to the left, when the weight will fall in the opposite direction from before and the tube M coming against the closed end of the U-bar R, will close the switch and again admit water into the tank W. This cycle of operation continues with almost no attention. W. L. PARKER.

Elgin, Ill.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

Elimination of Surface Condenser Leakage

IN THE Sept. 11 issue of *Power* there appeared an editorial in which it was advocated that condenser tubes be expanded into both tube sheets as a means of eliminating condenser leakage. Part of the third paragraph of this article reads as follows: "Various forms of stuffing boxes with tube packings, ranging from corset lacing and fiber to metallic packings, have been tried. None has proved absolutely leakproof owing to human and mechanical variables." In my opinion this statement is misleading, for there are thousands of surface condensers in use today that employ packings of the type condemned, where no trouble whatsoever is experienced from leakage that might be attributed to the packings.

Expanding condenser tubes into both tube sheets was a method adopted by the United States Navy in many of the destroyer and cruiser condensers. This practice continued for some years, and in each case the tubes were bowed to provide for expansion and contraction. It may be noted, however, that on the more recent scout cruisers built by the United States Navy, and for the condensers of those now building, this type of construction has been abandoned in favor of an assembly where the tubes are expanded into one tube sheet and packed at the other end in a standard, threaded, tube-sheet drilling from which the customary brass ferrules have been omitted.

It is a recognized fact that many condensers require frequent tube renewals, owing to the inability of present condenser tubes to withstand successfully the action of the circulating medium. In any condenser in which the tubes are expanded into both tube sheets, the removal and renewal of tubes becomes extremely difficult, especially where the tubes are bowed and do not pass through the condenser in a straight line. To remove them necessitates cutting the tubes off at both ends, inside of the condenser, for it is seldom possible to drift the expanded end through the tube sheet. Were it possible to drift the tubes through the expanded portion, the slight clearance provided in the tube-sheet drillings would make it difficult to withdraw the old tubes.

It would therefore seem sound engineering logic that until such time as condenser tubes can be obtained that may be relied upon to give long life without excessive failures, the assembly of these tubes in a condenser should be made in such a manner as to permit easy tube renewals. With this end in view there is no assembly more suitable than that where the tubes are expanded into one tube sheet and packed at the other end.

Condenser packings in one form or another long have been blamed for excessive condenser leakage. A thorough study of the subject would indicate that the packings are not always at fault. Many instances have been found where the tubes in surface condensers are subject to tremors, or vibrations, of such magnitude as to cause the destruction and disintegration of any type of packing.

Several years ago I recognized the deleterious action occurring in many of the larger condensing units throughout the country and in my analysis of the subject, written for and published by the Prime Movers Committee of the National Electric Light Association, I brought this matter to the attention of engineers and urged that serious consideration be given to dampening out such tube vibration, pointing out that unless this was done, it was entirely unreasonable to expect any type of packing to perform satisfactorily.

Many instances are found in surface condensers where vibrations occur to such an extent that the tubes literally chafe and wear away the tube metal. Also, many instances are found where these same vibrations, transmitted through the tube, result in crystallization of the tube metal where it is rigidly fixed by rolling of the tube into the tube sheet. Other instances may be cited where the tube vibration has been sufficient to loosen the tube at the front, where it is rolled into the tube sheet.

After an extensive study of the subject covering a number of years, which has brought me in contact with the largest condenser installations throughout the country as well as abroad, I am of the opinion that, if proper measures are taken to prevent condenser tube disturbance from vibration, little trouble may be expected from the condenser packings, and that unless condenser tubes are assembled or dampened to prevent tube vibration, such vibrating tubes will continue to cause serious leakage, whether packed or expanded into both tube sheets.

JULIAN N. WALTON, Mechanical Engineer,
Chicago, Ill. Crane Packing Company.

* * * *

Cutting Out Coils

IN THE issue of *Power* of Aug. 21, F. P. MacNeill discussed at length the cutting out of coils in the ice tank. To me all his calculations seem logical, with a single exception. In speaking of the volume of the tank coil and the condition of its contents, he states that "there are 125 cu.ft. in the entire coil. The vapor generated per second will be 0.4 cu.ft., the other 124.6 cu.ft. must contain liquid, for the compressor will have to take 0.4 cu.ft. away per second or the pressure in the coils will rise."

I agree that if 0.4 cu.ft. of gas is generated in the coils per second, the compressor will have to handle 0.4 cu.ft. of gas per second or the pressure will rise, but I do not agree that the other 124.6 cu.ft. in the coil will be filled with liquor. Mr. MacNeill has mixed his units of time and volume. Had the capacity of his compressor been stated in cubic-feet per minute, then it would have been 4x6 or 24 cu.ft. per min. Then would it not have been as logical to have said that since 24 cu.ft. of gas was being generated in the coil per minute, the other 101 cu.ft. was filled with liquid?

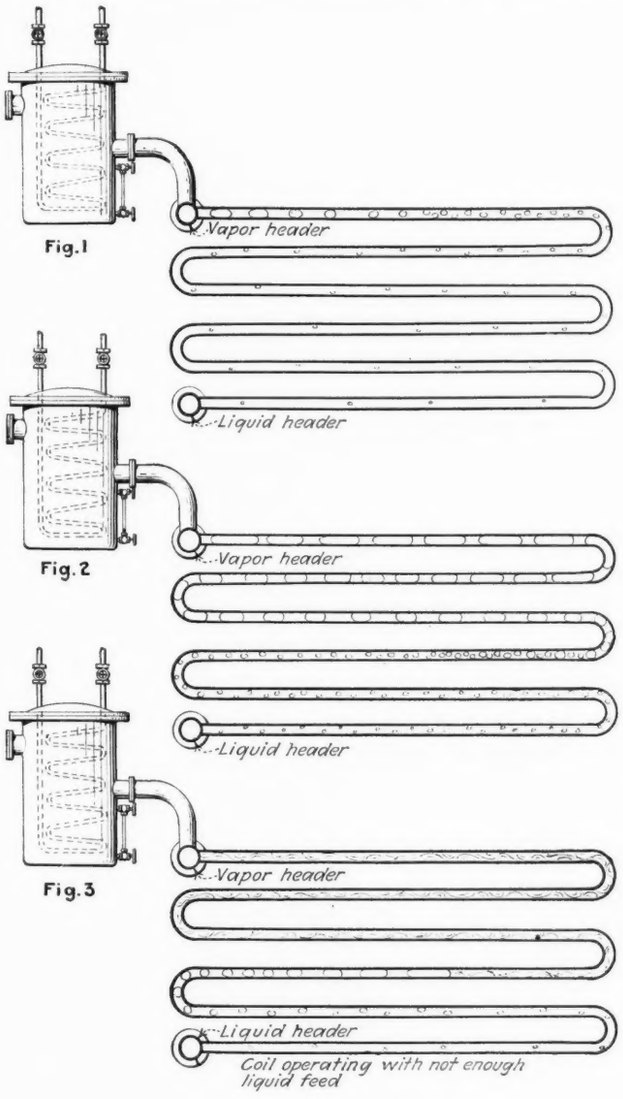
The amount of liquid in a tank coil bears no direct relation to the volume of gas that is being generated per second.

As an analogy, if a steam boiler contains 100 cu.ft. and is generating 40 cu.ft. of steam per second, does it mean that there is 60 cu.ft. of water in the boiler? No; it only

means that if the water level is to remain constant, the weight of boiler feed water must come into the boiler equal to the weight of the steam being generated.

Beaumont, Tex. R. F. SORRELLS.

Mr. Sorrells contends that the statement, "The other 124 cu.ft. must contain liquid, for the compressor will have to take away 0.4 cu.ft. of vapor per second or the pressure in the coil will rise is wrong. If he had read on a little farther he would have found the statement, "If the coil does not contain 124.6 cu.ft. of liquid at any particular instant, the coil is only partly full and superheating is taking place."



Action in a coil

Now it was plainly stated that the coil was performing a very light duty making 10 tons of ice daily, where it was designed to make 50 tons daily. Secondly, it was operating under a very high back pressure, 40.2 lb. gage. Finally, the object of the discussion was to show that to operate the entire coil properly it must be kept full, and vapor not allowed to accumulate within it or superheating would take place, increasing the volume of the suction to such an extent that a small pump-out machine would not be able to handle it.

The statement is designed to apply in that case only, and should not be assumed to cover all conditions that might exist. Under the assumed conditions there is a small quantity of heat distributed over a large area. As the pressure within the coil is relatively high and the heat entering per unit of area is very small, the size of the vapor bubbles generated will be small. There being 19 stands of pipe in the coil, the volume of vapor generated in each stand per second will be 0.021 cu.ft. This has to be distributed over 652 lin. ft. of pipe. Now the time taken for these bubbles to reach the outlet will vary according to the distance from the outlet at which they are generated and also according to their size, which will range from the size of the head of a pin at the bottom of the tank, to a full-bore bubble two in. long near the outlet. It is only at this latter place that the vapor volume can be considered, for unless the bubble is full-bore, the inside of the pipe is wet and can be figured wetted surface.

In actual practice in the case under discussion the liquid feed is so adjusted to keep the coil full and spilling over a slight amount into an accumulator as depicted in Fig. 1, which shows one stand of pipe. The conditions within the coil as shown are based on the experience and investigations of persons qualified to know. Conditions prevailing when the coil is operating to its full capacity are shown in Fig. 2. In this connection it may be stated that it is inconsistent to take the stand Mr. Sorrell does and say that I have mixed my units of time and volume, for when the vapor generated per minute at full capacity is calculated, it amounts to over 213 cu.ft. per min. and the coil contains only 125 cu.ft. A little thought will show that the time factor has to be reduced to seconds to arrive at some notion of conditions within the coil. Space does not allow of enlargement of discussion on this phase.

The statement that "the amount of liquid in a tank coil bears no direct relation to the volume of vapor generated" is not correct, as a little consideration will show. If the coil contains much liquid, its evaporating surface is greater than if it contained little liquid, therefore its power to generate vapor is greater. The attempt to draw an analogy between an ice-tank coil and a steam boiler is worthless, for the reason that the conditions are entirely different. Ammonia and water are different in their actions; the ice-tank coil operates at a low pressure with a small temperature difference between brine and ammonia, while the boiler operates at a high pressure and has a great temperature difference between fire and water.

Ammonia is much more volatile than water and far more susceptible to temperature and pressure changes. If two adjacent stands of pipe of an ice-tank coil, connected to the same suction header, take up slightly different amounts of heat from the brine, the one receiving the greater amount of heat will generate more vapor, set up a higher local pressure and stop the evaporation in the neighboring coil until it has boiled away enough of its liquid so that this excess pressure will fall to that of its neighbor; thereafter they will proceed to evaporate evenly. During all this time there will be no perceptible change in the pressure gage on the suction header. I will not agree with Mr. Sorrell that the statement that incited his criticism was illogical, but I will agree that it was not properly qualified, for if the compressor did not take away 0.4 cu.ft. of vapor per second, the pressure would rise anyway, whether the coil contained liquid or vapor. In the latter case the coil could not be said to be full, but a great part of it acting as a superheater, tending to raise the temperature, pressure and volume of the vapor generated, so that the pump-out machine could not handle the vapor quickly enough to make ten tons of ice daily.

New York City. FRANK P. MACNEILL.

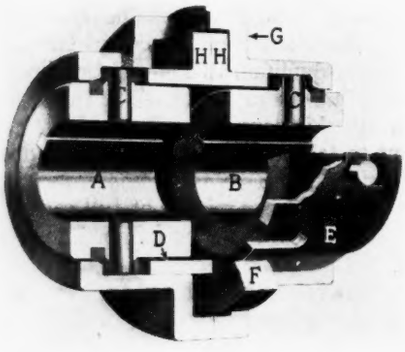
What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Flex-Ring Shaft Coupling

A TYPE of flexible coupling known as the Flex-Ring has recently been introduced by the T. L. Smith Company, Milwaukee, Wis.

The coupling consists essentially of two hubs *A* and *B*, driving pins *C* in-



View of coupling showing constructional details

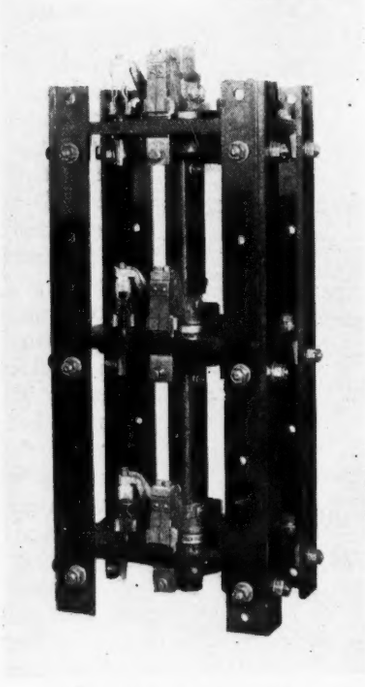
serted in the hubs, slotted sleeves *D* and *E*, the ring-shaped spring *F* and the split cover *G*. The slotted sleeves *D* and *E*, which engage the pins in the hubs, carry the extensions *H H*, and the torsional load or drive is transmitted through the ring-shaped spring *F*, which engages these extensions. The ring *F* also serves as a shock-absorbing member. The coupling is designed to permit considerable end play or float in the shafts as well as misalignment.

Portable Engine-Driven Arc Welder With Pneumatic Tires

IN THE Sept. 4 issue two types of portable Fuzon arc welders put out by the Fusion Welding Corporation, 103d Street, Chicago, Ill., were illustrated and described. This company now announces the introduction of a gasoline-engine-driven portable unit in two sizes, 200 and 300 ampere ratings, fitted with wire wheels and pneumatic tires. The unit is especially suitable for hauling around the shop or yard by hand or for hitching to a car or truck and being pulled to a job.

Type TF Transformer Tap Changer

THE type TF tap changer for power transformers illustrated, manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is used for changing tap connections from the outside of the transformer case, and is intended for operation only when the transformer is disconnected from the lines. It is adaptable to both



Tap-changer assembly

single-phase and three-phase transformers.

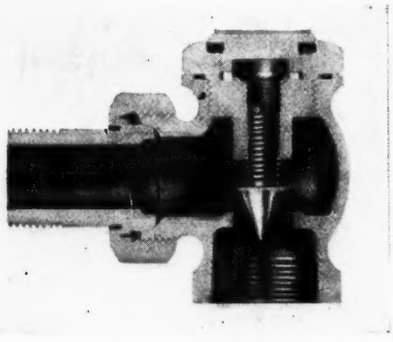
A micarta baseplate supports a large center bearing and the stationary contacts at the periphery of the switch arm circle, the latter being bridged by a cast alloy arm carrying the contact fingers. The baseplate is cut away between contacts to increase the creepage distance. Riveted and bolted contact fingers, with heavy cantilever springs, copper shunt for prevention of the annealing of the spring, and self-cleaning contacts are features of the mechanism.

The tap changer is mounted on the transformer under oil, and the operating shaft is brought through the cover by means of a specially constructed oiltight and airtight stuffing gland, which prevents seepage. The insulating shaft leading to the external operating mechanism of the transformer cover is provided with a micarta barrier. This decreases the necessary length of the insulating shaft and eliminates the necessity of excessive heights in transformer tanks.

Broomell Hot Water Flow Control Fitting

THE adjustable cone-shaped valve illustrated, known as the Broomell flow control fitting or circulation balancer, has been brought out by the Vapor Heating Co., York, Pa. The valve is especially designed for controlling the circulation to radiators in hot-water heating systems, domestic hot-water or ice-water circulating systems.

The fitting has the same roughing-in dimensions as the standard union elbow, so that the installation of the fitting on systems already in use is



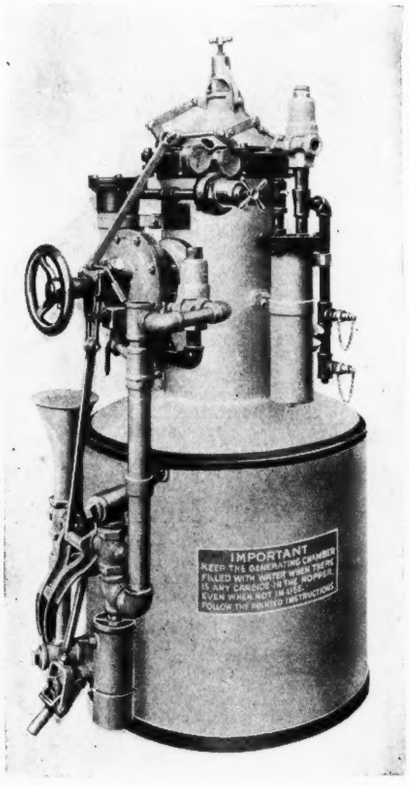
Section of flow fitting

readily made. The regulation of the flow through the fitting is by adjustment of a cone-shaped valve having a screwed stem. The upper end of the stem is slotted to take a screwdriver, and access is had to it through a removable cap in the bonnet, which is sealed tight by means of a gasket.

The fittings may be obtained in the standard pipe sizes from ½- to 2-in.

Improved Medium-Pressure-Type Acetylene Generators

THREE medium - pressure - type acetylene generators for welding and cutting have been brought out by the Oxweld Acetylene Company, 30 E. 42d St., New York City. The type MP-2 generator, built in two sizes having 50 and 100 lb. carbide capacity respectively, replaces the earlier medium-pressure generator while the type MP-3, having 300 lb. carbide


IMPORTANT
KEEP THE GENERATING CHAMBER
FILLED WITH WATER WHEN THERE
IS ANY CARBIDE IN THE HOPPER,
EVEN WHEN NOT IN USE.
FOLLOW THE PRINTED INSTRUCTIONS

Medium-pressure generator

capacity, is a new unit. These three generators are suitable for supplying pressure-type or medium-pressure welding and cutting blowpipes.

The type MP-2 generator is, in many respects, similar in construction and operation to its predecessor. The feed mechanism has been redesigned to make the carbide shutoff more positive. A new method is used to stop the carbide feed in case the diaphragm breaks or zero pressure exists in the generator.

A new regulator, the type R-40, is furnished instead of the line regulator formerly used. This regulator is of the stem type, having a large stem and seat to provide ample capacity, and is equipped with two gages. One of these indicates the pressure in the generator and the other the pressure in the delivery line.

The hydraulic back-pressure valve, which has been simplified, and the filter are of seamless steel tubing assembled by bronze-welding and then galvanized. The vertical pipe leading downward to the back-pressure valve and extending below the surface of the water, is fitted with an angle check valve. In case back pressure is exerted, water will be forced up the vertical pipe, causing the check valve to close and preventing the possibility of back pressure or flash reaching the interior of the generator.

An important feature of the new units consists of interference levers which unseat the relief valves every time the generator is recharged. This arrangement automatically prevents the relief valves from sticking. Since the relief valve on the hydraulic back-pressure valve opens only momentarily, no acetylene from the line is lost during recharging. A conveniently placed clean-out door renders the feed mechanism parts accessible and easy to clean without dismantling the generator.

The type MP-2 generators use $\frac{1}{4}$x$\frac{1}{2}$-in. carbide. Shipping weight in the 100-lb. size is 1,100 lb. and in the 50-lb. size 925 lb. The former has a diameter of 3 ft. 5 in. and the latter 3 ft. 1 in.

The type MP-3 medium-pressure generator has been designed to meet the demand for a pressure-type unit of large capacity that will supply gas with a minimum pressure fluctuation.

The same principle of carbide feed as used in the balance-seal generator is used in the type MP-3. The feed is driven by a motor actuated by a weight. A diaphragm pressure control is used in connection with the motor to regulate the feed and maintain proper pressure in the generator. The feed shaft bearing is protected by a dustproof cover which protects it from carbide dust. A clean-out door is provided which permits cleaning the carbide feed disk without removing the generator top. The filter can be repacked, if necessary, without breaking any adjustment of interference or relief valves. This operation is performed by removal of the top plate.

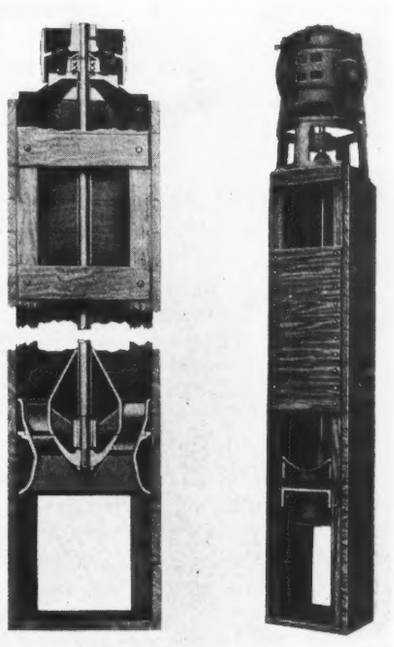
The hydraulic back-pressure valve is so arranged that it is always filled with water before the generator itself is entirely filled. An overflow-level check plug has been provided in order that the operator may check the water level at any time.

This generator uses $1\frac{1}{4}$x$\frac{3}{8}$-in. carbide. The over-all height is slightly over 120 in., and the height to the top of the generator shell is 104 in. The diameter of the shell is $42\frac{1}{2}$ in. and the shipping weight 2,300 pounds.

"Everglades" Screw Pump

A NEW type of screw pump known as the "Everglades," designed for handling large volumes of water at low head as required in drainage work and similar services, has been brought out by Fairbanks, Morse & Company, Chicago, Ill.

The pump is a vertical unit consisting of cast-iron spiders carrying a wood screw type impeller and diffuser



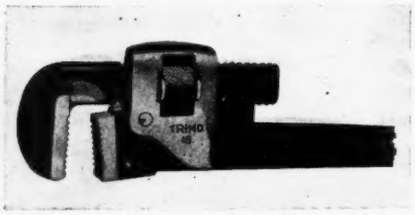
Screw pump for handling large volumes of water at low head

and constructed in such a manner that four wooden corner posts are fastened to the spiders and the structure boarded up so that it may be placed vertically in a trench or stream and arranged to discharge over the top of the levee or embankment.

The pump is well adapted for direct connection to vertical motors, for belt drive for motors or internal-combustion engine using one-quarter twist belt, or by means of a gear box which may be provided at the top of the pump. It may also be direct connected to internal-combustion engines or belted to the gear box, thus eliminating the quarter twist in the belt. The general arrangements of the belt-driven and motor-driven units are shown in the illustration.

Improved "Trimo" Pipe Wrench

A MATERIAL increase in strength and safety are features of the improved Trimo pipe wrench announced by the Trimont



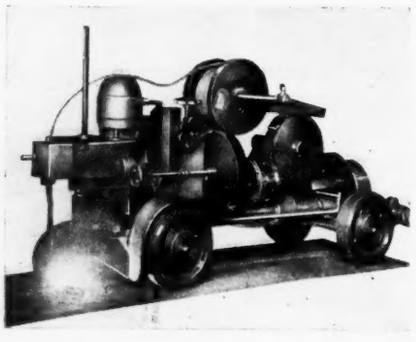
Improved "Trimo"

Manufacturing Co., Roxbury, Mass.

The adoption of a newly developed method of heat treating has made possible a material increase in the strength and toughness of the wrench handle. The strength of the swinging steel frame has also been materially increased. As an additional safeguard overlapping side lugs, an integral part of the handle, brace the frame against lateral distortion or spreading. The replaceable insert lower jaw and nut guard, which protect the adjustment, have been retained on the new type.

Automatic Tractor-Type Welder

AN AUTOMATIC tractor-type arc welder utilizing the electronic tornado principle (see *Power,* June 5, 1928) and used for making lap and butt welds on large tank bottoms,



Welder in action

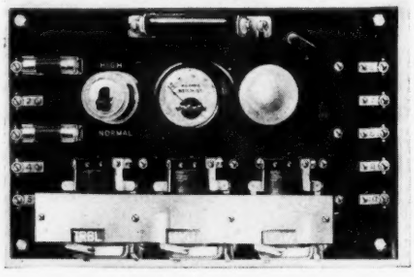
roofs, large pipe and similar work, has been brought out by the Lincoln Electric Company, Cleveland, Ohio. The machine, as shown in the illustration, consists of an electronic tornado head mounted on a self-propelled four-wheel-drive carriage. Power is supplied through a flexible cable, and all that is necessary is to line up the machine over the seam to be welded and to start the arc.

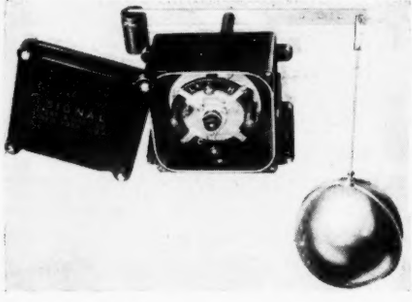
In making lap welds with this machine, no additional filler metal is used. The heat of the carbon arc fuses the edge of the top plate into the lower plate, making a leakproof joint. A filler strip is laid over the seam to be welded when a butt weld is desired.

The chief advantages claimed for this machine are high welding speeds and smooth uniform welds. Speeds on $\frac{1}{4}$-in. lap joints varying from 50 to 75 ft. per hour are obtained.

High- and Low-Water Alarm for Elevated Tanks

THE illustration shows a high- and low-water tank alarm system manufactured by the Signal Engineering & Manufacturing Company, New York City. The alarm,





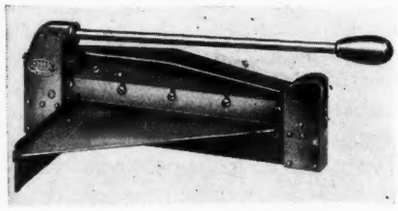
Relay board and float-operated, three-wire, high-low level tank switch

which is designed to indicate the water-level limits in an elevated water-supply tank, consists of a single copper float ball operating a three-wire high-low level tank switch, tank bell, trouble bell and control panel.

The control panel is inclosed in a steel cabinet with a glass door and consists of a panel board on which are mounted milli-ammeter, red lamp, transfer switch, test plugs, wire terminals and three relays. Each of the relays has a properly worded target which appears only when the relay is operated. The tank alarms form a complete system to operate standard single-stroke and vibrating bells. The circuits are so arranged that complete electrical supervision is maintained over all wires.

Cutter for Belts Up to 10-In. in Width

A 10-IN. open-end belt cutter has been announced by the Clipper Belt Lacer Company, of 974 Front Ave., N. W., Grand Rapids, Mich.



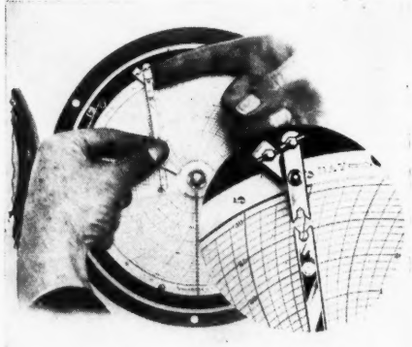
Open-end belt cutter

The cutter is comparatively light in weight and readily portable.

The new cutter will cut and square any make of belting up to and including 10 in. in width with a slight pressure on the handle. The machine is made of malleable castings, cold-rolled steel and tool steel. As a measure of safety it is so constructed as to make it impossible to raise the blade high enough to become dangerous.

Detachable Pen Arm for Recording Instruments

THE employment of a detachable pen arm with open end, which can be quickly replaced if bent or broken, is a recent improvement made to the line of recording instruments



Pen arm with open ends to facilitate removal and replacement

put out by the Foxboro Company, Inc., Foxboro, Mass.

As shown in the illustration, the pen arm is readily detached with the finger nail and a new one slipped into place. The lower end of the pen arm is also made open to facilitate the removal, cleaning and inking of the pen and to keep the pen arm clean.

Welding Society Holds
Fall Meeting and Exposition

Welding of Steel Structures, Automobiles, Job Welding, Pressure Vessels, Airplanes and Direct-Current Machinery Shows Progress in Technique

A WIDE range of industries was covered by papers presented at the fall meeting of the American Welding Society in Philadelphia, Oct. 8-12. Technical sessions were held at the Bellevue-Stratford Hotel, and also in the assembly room of the Commercial Museum, which housed the National Metal Exposition in which welding equipment and material played a prominent part. This exhibition gained strength from the fact that it was held simultaneously with conventions of the A.W.S., the A.S.S.T. and the Institute of Metals Division of the A.I.M.E. This combining of related fields resulted directly from the success of a similar arrangement at Detroit last spring.

Papers presented at sessions of the American Welding Society covered applications of welding steel structures, automobiles, job shops, pressure vessels, airplanes and direct-current machinery.

Welding exhibits at the National Metal Exposition in the Commercial Museum included welding machines, hand and automatic, cutting and welding torches, welding electrodes, and many examples of work done. In spite of the distance of the Museum from the center of the city the attendance was large.

Tuesday Afternoon

Industries employing welded piping and pressure vessels at temperatures up to 1,000 deg. F. should profit from the

> *Welding is now used in almost every conceivable field where metals are employed. It is particularly adapted to the construction and repair of steel structures, pressure vessels, piping, sheet-metal work, motors and generators, automobiles, aircraft, ducts, stacks, bunkers, tanks, fans, machine frames and supports.*

elevated-temperature tests of welds conducted by the San Francisco Section of the American Welding Society and the Materials Testing Laboratory of Stanford University. The committee report, which was presented at the Tuesday afternoon session, gave test results and microphotographs of gas and electric welds made with various welding rods. The outstanding conclusion from the work so far is that the best welds at normal temperature are also the best at higher temperatures, and that welds can easily be produced to be stronger than the base metal at any temperature up to 1,000 deg. F., the upper limit of the tests.

Wednesday Morning

In the Wednesday morning session S. W. Miller, consulting engineer, Union Carbide & Carbon Research Laboratory, presented for consideration a new formula for fixing the maximum allowable working fiber stress in welded structures. This formula takes account of the ductility, as well as the ultimate strength, of the weld and was chosen empirically to give values that experience had shown to be both safe and economical. The formula, which was derived by A. B. Kinzel, of the Union Carbide & Carbon Research Laboratory, is as follows:

$$S = \frac{T}{7.15}\sqrt[3]{\frac{E}{10}}.$$

In this S is the allowable working fiber stress, T the ultimate tensile strength and E the percentage of elongation as determined by the "bend test."

The essential feature of the "bend test" is that there must be no restraint at the bend during its making, which is done by slightly kinking the piece at each end somewhat outside the weld, say an inch or so from it, and then bending it endwise as a column in a testing machine, vise or press. At the first sign of cracking the bending is stopped, and the distance (along the curve of the bend) between the gage marks previously laid out in the weld metal is again measured, the elongation being computed as in the usual tensile test. This being also a test of the weld metal, the reinforcement should be ground off.

According to Mr. Miller this bend test has much greater practical significance than the customary tests for reduction in area or per cent elongation in eight inch or two inch.

The accompanying table gives the results computed from this formula for various values of ultimate strength and per cent elongation.

Commenting on this table and formula, Mr. Miller made several comparisons with existing practice:

"In the Pressure-Vessel Code, while the allowable stresses are really based on a factor of safety of about five for riveted construction, a definite fiber stress of 10,000 lb. is permitted for plates less than 55,000 lb. ultimate strength, and 11,000 lb. for plates of 55,000 lb. or greater ultimate strength. So it might be feasible to simplify the table by adopting some plan similar to that in the Pressure Vessel Code.

> *Welds can easily be made by the electric and gas processes to be stronger than the base metal at all temperatures up to 1,000 deg. F. The welds that show up best at ordinary temperatures are also the best at higher temperatures at least up to this limit, according to experiments reported by the San Francisco section of the A.W.S.*

"It is rather interesting that it so happens that the allowable fiber stress at 50,000 lb. and 5 per cent elongation is 5,600, the same as is used in the Pressure-Vessel and Heating-Boiler Codes.

"At the values of tensile strength and elongation of cast iron, say 20,000 lb. and 0.2 per cent, the formula gives a fiber stress of 750 lb. As a common factor of safety for cast iron under shock is 20, the formula does not seem to be unreasonable at this extreme.

"At the other end we may take nickel steel that has been used for boilers. It has a tensile strength of 70,000 lb. and

PROPOSED MAXIMUM ALLOWABLE WORKING FIBER STRESSES IN LB. PER SQ.IN. OF PLATE SECTION FOR WELDED-STEEL PRESSURE VESSELS

Per Cent Elongation by Bend Test	Ultimate Strength in Thousands of Lb. per Sq.In.							Factor of Safety
	45	50	55	60	65	70	75	
5	5,000	5,600	6,100	6,700	7,200	7,800	8,300	9.0
7½	5,800	6,400	7,000	7,700	8,300	8,900	9,600	7.8
10	6,300	7,000	7,700	8,400	9,100	9,800	10,500	7.15
12½	6,800	7,600	8,300	9,000	9,800	10,500	11,300	6.65
15	7,200	8,000	8,800	9,600	10,400	11,100	12,000	6.25
17½	7,600	8,400	9,300	10,100	11,000	11,700	12,700	5.9
20	8,000	8,800	9,700	10,600	11,400	12,300	13,200	5.7
22½	8,300	9,200	10,100	11,000	11,800	12,800	13,700	5.5
25	8,600	9,500	10,500	11,400	12,400	13,200	14,200	5.3

an elongation of 23 per cent (obtained by the tensile test and not by the bend test). The formula rating for this material is 12,900 lb., and with a factor of safety of five it would be allowed 14,000 lb. working stress. Therefore, it seems that the formula is within reason and does not violate good practice, even at the extremes."

The formula, Mr. Miller pointed out, is prepared for use only where welding is carried out under proper procedure control.

Friday Morning

While not of direct interest to power engineers, the almost universal use of welding for the fabrication of airplanes is significant as indicating the suitability of welding for structures where safety under heavy and unexpected loads

> *A new formula proposed for fixing the allowable stresses in welded structures, particularly pressure vessels, takes account not only of the tensile strength but of the ductility as determined by the simple and practical bend test. This formula may eventually lead to new rules for pressure vessels.*

is a matter of life and death. At the Friday morning Technical Session, H. L. Whittemore, of the Bureau of Standards, and H. H. Moss, of the Linde Air Products Company, discussed the testing of joints for aircraft structures under procedure specifications.

This was followed by a significant paper, "Standard Line of D.C. Machines Fabricated by Arc Welding," by Messrs. R. F. Marthens, C. C. Brinton and F. T. Hague, of the Westinghouse Electric & Manufacturing Company. The following excerpts from this paper indicate the progress being made in the substitution of welds for castings in electrical machinery, and particularly direct-current machines.

"Direct-current machines have not been the first to be completely fabricated by electric arc welding. Electrical manufacturers have generally followed through the development of simpler types of alternating-current synchronous machines, accumulating experience in fabrication and developing correct welding technique as applied to electrical structures, before undertaking the fabrication of the direct-current machine. Under these circumstances the completely fabricated direct-current machine can reasonably be expected to benefit from this already accumulated manufacturing experience.

"An existing line of direct-current machines using castings cannot be changed over to the arc-welded fabricated construction simply by replacing castings with similar fabricated constructions, without sacrificing many of the attractive possibilities which the new method of construction makes possible.

"A particularly valuable feature of fabricated construction in direct-current machines of medium and large size is the design flexibility of the arc-welded construction that permits a wide application of any given element of the machine. This feature alone has an economic aspect which justifies the complete redesign of the entire line of machines to take full advantage of all the opportunities of flexibility in design.

"The present demand is for special electrical ratings and constructions, and this must be met with low-cost apparatus, unburdened by high development charges. The arc-welded fabricated construction makes possible the necessary flexibility in design to meet these requirements in direct-current machines.

"The development of the arc-welded fabricated construction has made it possible to combine the contrary requirements of design flexibility and low manufacturing cost by the application of the standard-part idea to electrical machine design. Basically, the standard-part plan means the separation of a direct-current machine into parts or elements, some of which can be used in all different designs and others which will generally change with every design. The major mechanical elements, such as frames, armature spiders, punching blanks, are obviously constant parts which can be standardized. Windings in general are variable elements that change with every rating.

"The fabrication of a line of machines requires considerable special factory layout and equipment. The full advantages obtainable from the arc-welded constructions can be realized only by courageous scrapping of existing manufacturing equipment and the installation of new equipment of novel type. In place of the foundry there will be substituted furnaces and bending rolls for the rings used in the direct-current frames. In place of the machine tools there will be automatic gas-cutting machines, and, finally, automatic welders, etc., required for fabricating. Thus, there are heavy initial development costs that must be incurred before manufacturing can begin.

"Special equipment is essential to produce the parts for the direct-current machines, some of which it has been necessary to develop in order to meet the requirements of manufacture of heavy frame rings. The equipment for making these rings includes a furnace for heating the heavier slabs for bending. A set of motor-driven roll tables with hydraulic turn-over apparatus handles these slabs from one operation to the other. A crimping press and a vertical three-roll bender completes the equipment for the manufacture of the rings. The crimper is a 1,000-ton hydraulic press equipped with dies for bending the slab ends before going through the bender. This makes it unnecessary to cut off or bend by hand the straight ends left when such rings are bent in a three-roll bender.

"A desirable saving is made in development by the elimination of the patterns and the continuous changing of patterns to obtain the foot height required in different installations. Delivery time is also reduced as a natural result of fabrication, in that there is no pattern to make or remove from storage and no likelihood of scrapping castings.

"The armature spider is composed of two hub rings and the necessary arms, both burned from steel plates. The spider arms are notched by gas cutting to receive the hub rings. The end plates, as well as the commutator supporting ring, are also burned from steel plates.

"The number of stock sizes required is surprisingly small, considering the possible variations in shaft diameter and core length covered by the complete line of machines. It has been possible to design 68 combinations with only eight bar sections for the spider arms and two plate thicknesses for the hub rings, end plates and commutator supporting rings."

The rapidly growing importance of welding in the structural field was evidenced by three papers: "Design of Welded Structures," by F. P. McKibben, consulting engineer, General Electric Company,; "Erecting a Building by Welding," by J. F. Lincoln, Lincoln Electric Company; "Oxyacetylene Cutting in the Structural Field," by D. E. Roberts, Linde Air Products Company.

Other papers were, "Welding in the Automobile Industry," by J. W. Meadowcroft, and "Running a Successful Job Welding Plant," by J. S. Oechsle.

A meeting of the Joint Pressure Vessel Committee of the A.S.M.E. and the A.W.S. was held on Thursday morning. Friday afternoon was devoted to meetings of the American Bureau of Welding (the Research Department of the Society) and the Structural Steel Welding Committee.

Social events included the Grand Ball at the Benjamin Franklin Hotel on Tuesday evening, and the Annual Banquet and Dance at the Bellevue-Stratford on Thursday evening. Special entertainment was provided for ladies.

> *Welding has made notable progress in the fabrication of alternating-current motors and generators. It is now advancing in the field of direct-current practice, where some of the advantages of mass production may be attained by welding, in spite of the great variety of designs needed to meet special conditions.*

Three inspection trips were arranged for the delegates on Wednesday afternoon, the plants visited being the Naval Aircraft Factory, League Navy Yard, and the welded building of the General Electric Company at West Philadelphia.

Effect of Reinforcing Pad
for Nozzle Connections

Although much excellent work has been done on the design of dished heads, little reliable data existed with reference to stresses around nozzle openings. Because of this the M. W. Kellogg Company undertook last fall to run a test on a tank containing nozzles, both reinforced and unreinforced, with the idea of developing an empirical formula that would permit holding the stress around the nozzle down to that in the free part of the shell. The results of these investigations were given in a paper by H. Leroy Whitney and presented by R. K. Hopkins, of that company, before the last convention of the National Board of Boiler and Pressure Vessel Inspectors.

EXPERIMENTS were made on a 60-in. inside diameter vessel, 1¼ in. thick by 10 ft. 6 in. long, to which a 14-in. inside diameter flued nozzle was attached. For the first test a 1-in. thick reinforcing plate was attached. The test was run on the reinforced nozzle first so that the pressure could be carried up to a higher point without affecting the unreinforced nozzle, which at this time had not been attached to the tank. After the first test had been completed, an unreinforced nozzle of the same dimensions was attached diametrically opposite the first nozzle in the same tank and was tested under the same conditions.

In order to give a clearer idea of how the reinforcing plate was applied to the nozzle in the first test, the following description is given:

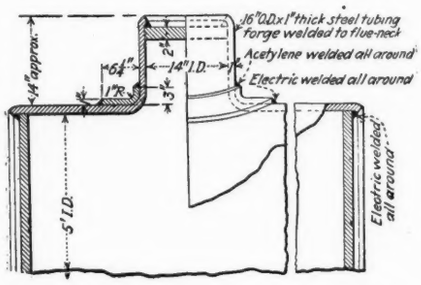


Fig. 1—Showing method of attaching nozzle and pad

A disk 28½-in. outside diameter by 1-in. thick was fitted closely to the shell at the point where the nozzle was to be. This disk had a hole in its center slightly larger than the hole cut in the shell. It was tack-welded into place, after which the disk and the shell were heated and flued out into a common die. After the fluing was completed, the neck of the pad was acetylene-welded to the neck of the nozzle. A piece of tubing 14 in. inside diameter by 16 in. outside diameter was then forge-welded to the neck of the nozzle, and during this forging operation the acetylene welding at the top of the reinforcing pad was forged into the neck of the nozzle at the same time. The opening in the end of the nozzle was closed with a flat plate (see Fig. 1).

The vessel was placed in a horizontal testing machine with the heads backed up in such a way that there was no chance of excess pressure being developed on them in either direction. After the tank had been filled with water an internal pressure of 400 lb. per sq.in. was applied and held for an appreciable length of time in order that the vessel could assume its natural shape before strain-gage readings were taken. The internal pressure was reduced to zero and after several minutes a set of zero readings was taken. Pressure was then raised to 200 lb. and readings taken again. Readings were taken at 200, 400, 500, 600, 700, 800 and 900 lb. Between these readings the pressure was reduced to zero when another set of zero readings was taken. Stresses were calculated from the various strain-gage readings and the curves indicating these stresses are given on Fig. 2. It will be noted from these curves that the stresses nearest the knuckle of the flued opening are less than the stresses in the shell, while those adjacent to the reinforcing pad are only slightly higher than the stresses in the shell.

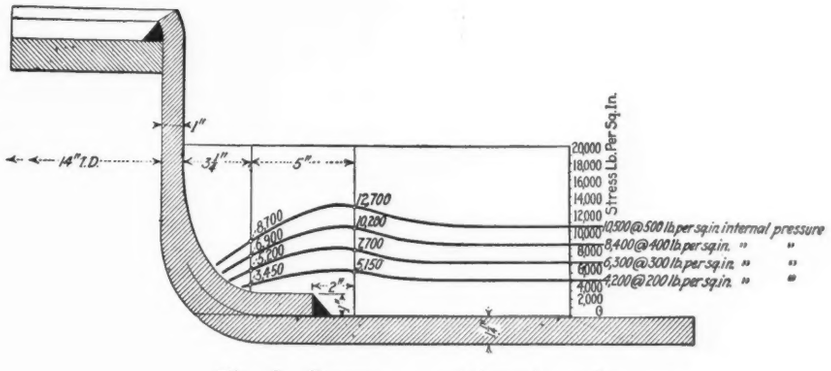


Fig. 2—Stresses on reinforced nozzle

After this test was completed, the vessel was returned to the welding shop and an unreinforced nozzle was attached. The strain-gage readings were taken every 100 lb. up to 500 lb., the pressure each time being lowered to zero. At 500 lb. pressure the stress indicated at the point nearest the knuckle of the nozzle was approximately 37,600 lb. per sq.in. Permanent set readings were taken after applying pressures of 600, 700 and 900 lb. per sq.in. After the 900 lb. had been applied, it was decided to increase the pressure until failure. This was done and the tank broke through some fault in the plate at an internal pressure of 1,200 pounds.

Curves indicating the stress calculated from the strain-gage readings are given in Fig. 3. It will be noted that the ratio of maximum stress at the base of the nozzle to the shell stress increases as the internal pressure increases, the ratio at 500 lb. internal pressure being approximately 3.45 to 1.

The readings on the neck show very little increase in stress over that in the shell. This fact indicates that the reinforcement of a nozzle should be on the tank shell around the base of the nozzle and any reinforcement around the neck of the nozzle would have little, if any, effect on reducing the stresses. This seems contrary to the customary idea that the neck of the nozzle has considerable reinforcing effect for an appreciable distance up from the shell.

It is concluded from the tests that a reinforcing pad of the type tested is of material benefit and should be used where the stress in the plate at working pressure is high. It is felt, however, that a plain nozzle, as normally used, is amply efficient to serve its purpose when the stress in the wall of the vessel is at a comparatively low value.

At 500 lb. pressure the maximum stress for the plain nozzle was 345 per cent of the shell stress. The maximum stress in the reinforced nozzle, at this same pressure, was 121 per cent of the shell stress. It will be remembered that the thickness of the reinforcing pad was 1 in. while the shell thickness was 1¼ in.; in other words, the pad was 80 per cent as thick as the shell. This means that by using a reinforcing pad whose thickness is 80 per cent of shell thickness, the maximum stress was reduced from 345 per cent of shell stress in the plain nozzle, to 121 per cent of shell stress in the reinforced nozzle.

It can be seen from the foregoing that an advantage of 224 per cent of shell stress was realized by the use of the pad. From a direct comparison of these two stresses and thickness the required pad thickness can be found which will keep the maximum stress around the nozzle equal to the shell stress.

From a general study of this test it is felt that if a pad having a thickness equal to the thickness of the shell is properly attached to the nozzle opening, the maximum stress around the nozzle will not exceed the stress existing in the wall of the vessel.

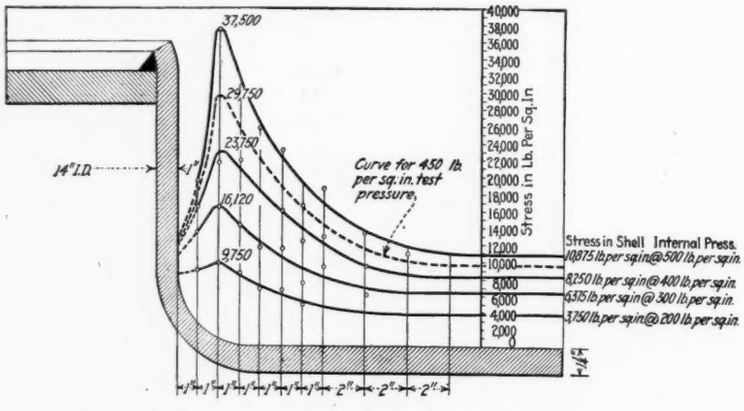

37,500
29,750
23,750
16,120
9,750
14"I.D.
Curve for 450 lb. per sq. in. test pressure.
Stress in Lb. Per Sq. In.
Stress in Shell Internal Press.
10,875 lb. per sq. in. @ 500 lb. per sq. in.
8,250 lb. per sq. in. @ 400 lb. per sq. in.
6,375 lb. per sq. in. @ 300 lb. per sq. in.
3,750 lb. per sq. in. @ 200 lb. per sq. in.

Fig. 3—Stresses on nozzle without reinforcing pad

RECENT PUBLICATIONS

PATENT LAW AND PRACTICE. By Oscar A. Geier. Published by Richard & Geier, 274 Madison Ave., New York City. Cloth; 6x9 in.; 46 pages. Copies available without cost.

IN THIS book, its twelfth edition, are included the great number of changes in the rules of practice in the United States Patent Office that have taken place since the edition of 1924. The book gives a digest of the patent law and practice and discusses the procedure in the Patent Office. The author goes on to discuss, under separate headings, such topics as re-issues, infringements and infringement suits, assignments, grants and licenses, foreign patents, trademarks and copyrights.

GENERAL RULES AND REGULATIONS PRESCRIBED BY THE BOARD OF SUPERVISING INSPECTORS — OCEAN AND COASTWISE VESSELS. Published by the Steamboat Inspection Service of the Department of Commerce. Paper; 6x9 in.; 252 pages.

THIS edition contains all amendments of the Ocean and Coastwise Rules and Regulations made by the Board of Supervising Inspectors at the meeting of January, 1928, and by the Executive Committee of the Board at meetings during February, April, October and November, of 1927. These amendments to the rules and regulations have been approved by the Secretary of Commerce, and have the force of law.

Rules 1 and 2 of this issue, comprising a total of 56 pages, deal with the construction and inspection of boilers and auxiliary equipment. The book also contains a list of all approved vessel equipment.

THE THERMAL EXPANSION OF FIRECLAY BRICK. By Albert E. R. Westman, Research Association in Ceramics Engineering. Bulletin 181, Engineering Experiment Station, published by the University of Illinois. Paper; 6x9 in.; 30 pages.

THIS bulletin is a report of an investigation of the thermal expansion behavior of twenty brands of fireclay brick for the temperature range from room temperatures (25 deg. C.) to approximately 900 deg. C. (1,652 deg. F.) along with other properties which would be of interest in connection with these data. The accumulation of a large part of the data as given in this bulletin was made possible by the generosity of the Utilities Research Committee. The bulletin contains tables showing data pertaining to the manufacture of the brick, the analysis of the fireclay and physical properties. Curves are also included was done to determine the percentage of showing linear expansion in per cent of length at 25 deg. C. Additional work cristobalite and quartz in the brick, and the results were used to explain inflection points that occur in the expansion curves.

A LABORATORY FURNACE FOR TESTING RESISTANCES OF FIREBRICK TO SLAG EROSION. By Ralph K. Hirsch and Chester E. Grigsby. Circular No. 17, Engineering Experiment Station. Published by the University of Illinois, Urbana. Paper; 6x9 in.; 18 pages.

THIS circular contains a description of a laboratory furnace developed for the purpose of determining the relative resistance of different brands of firebrick to the action of slag such as produced by Illinois coal ash. The furnace developed is cylindrical in shape, about 14½ in. inside diameter, and is supported vertically on rollers so that it may be rotated about its axis at a speed of 13 r.p.m. It is heated to any desired temperature with controlled atmospheric conditions by a blast furnace using city gas and air, both at high pressure. Powdered slag is fed at a uniform rate through the burner and impinges with the blast on the vertical faces of the standard-sized test bricks which form the lining of the chamber. The melted slag flows down over the face of the brick and out through a point in the middle of the furnace bottom. Various illustrations show the comparative results obtained during test periods ranging from 20 to 30 hours duration.

WATER RESOURCES PAPER NO. 53—The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has recently issued Volume 53 of the Water Resources Papers, which deal with the surface water supply of Canada. This number contains the results of investigations made by the Dominion Hydrometric Survey during the climatic year Oct. 1, 1925, to Sept. 30, 1926, in the province of British Columbia. The report contains a short explanation of the purpose and scope of the work and 216 pages of stream-flow and meteorological data, with an index map showing drainage areas and the location of gaging stations. Copies may be obtained free of charge on application to the Director of the Dominion Water Power and Reclamation Service, Ottawa, Canada.

BONBRIGHT UTILITY REGULATION CHART—A chart showing the principal provisions regarding the regulation of utilities in the various states of this country has been published by Bonbright & Company, 25 Nassau St., New York. This chart is derived from an extensive analysis of the laws relating to public utility regulation, through the co-operation of the National Electric Light Association.

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Refrigerating Engineers Complete Louisville Convention Plans

Four Days to Be Crowded With Important Papers —Mechanical Man to Be Guest of Convention

THE National Association of Practical Refrigerating Engineers is looking forward to the biggest and best convention in the history of its organization. Interest already expressed by members in all parts of the country, and the general disposition to attend the convention, whether the trip be long or short, give undeniable indications that for enthusiasm and large attendance this meeting will set a new standard for the association. Louisville, Ky., is the spot chosen, and the dates will be Nov. 20 to 23, inclusive.

The program committee has provided a full schedule of papers dealing with all angles of refrigeration—theoretical, practical and descriptive. Actual operation information is given a prominent part in the list. An interesting feature also, will be a paper on the refrigeration of perishables while in railway transit.

The entertainment part of the program has not been overlooked, if we may judge by the assurances given by the committee, which is, however, keeping this part of the convention secret at the present writing. No more attractive city could be found than Louisville for a convention in the last weeks of the year, and it is certain that from every point of view the itinerary will be attractive to all who attend the convention.

At the request of the entertainment committee and through the kindness of the Westinghouse Electric & Manufacturing Company the famous mechanical man, or "televox," will be a guest of honor at the convention. While it is not indicated that he will be internally rearranged to perform any specific operations in the refrigeration field, prospective visitors to the convention are assured that his usual, or more exactly, his habitual, line of tricks will be presented. The mechanical man, latest claimant to the title of seventh wonder of the world, includes in his repertoire a recitation and a song, the ability to play the piano, sweep the house, wash the clothes and answer the telephone, and an aptitude for doing watchman's duty. He will, without doubt, be able to focus the attention of the entire convention upon the wonders of science.

Following is a schedule of the papers to be given before the convention. One interesting feature in connection with this part of the program is the fact that each session will be opened with a "question and answer" period, after which the scheduled papers will be read and discussed.

Tuesday, Nov. 20—"Repairs and Maintenance of Electrical Machinery," by J. R. Watson; "Cooling Water Problems in Refrigeration," by R. P. Mase and B. L. Barnhart; "Contact Between the Engineer and Employer," by Leslie C. Smith.

Wednesday, Nov. 21—"Cold Storage Operation," by Charles A. Conley; "Packing House Refrigeration," by Oscar A. Anderson; "Operation and De-Frosting of Cold Storage Piping," by C. A. Anderson; "Cork—Insulation and Other Uses," by E. C. Lloyd.

Thursday, Nov. 22—"Recent Developments on Evaporating Systems," by Thomas Shipley; "Federal Board of Vocational Education," by Frank Cushman; "New Type of Condenser," by B. F. Kubaugh; "Brine Circulation in Ice Tanks," by H. I. Lewis; "Modern Ice Plant Practice," by W. H. Mets.

Friday, Nov. 23—"Practical Plant Operation," by W. E. Bernd; "The Operation of Centrifugal Refrigeration Systems in Air Conditioning Plants," by R. W. Waterfill; "Railway Transportation and Preservation of Foodstuffs," by C. A. Richardson; "Fruit Storage Room Control and Its Operation Briefly Described," by N. M. Small.

A.S.M.E. Group to Share in Ceremonies at Southern Textile Show

Among the interesting features planned for the Southern Textile Exposition being held at Greenville, S. C., this week, is a special meeting of the Textile Section of the American Society of Mechanical Engineers. James M. Cox, chairman of the section, will preside, and the principal address will be delivered by Alexander Dow, who has been a leading member for many years. Mr. Dow was elected president of the American Society of Mechanical Engineers without opposition at the annual meeting in New York last December.

Plans Completed for Fourth Power Engineering Conference

The recent election of officers for the Fourth Mid West Power Engineering Conference scheduled for Feb. 11 to 14 inclusive, 1929, at Chicago, assures an organization well versed in the dissemination of power information covering the fields of generation, distribution and utilization. The work of carrying on the meeting has been placed in the hands of these officers: President, W. L. Abbott, Chicago; vice-presidents, C. C. Whittier, Chicago, A. A. Potter, Lafayette, Ind., C. F. Hirshfield, Detroit, and W. M. White, Milwaukee; secretary, G. E. Pfisterer; treasurer, K. A. Auty. Headquarters have been established at 53 W. Jackson Blvd., Chicago.

As before, the Conference will be sponsored by the local sections and regional divisions of the following societies: American Institute of Electrical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining & Metallurgical Engineers, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, National Electric Light Association, Western Society of Engineers and the National Safety Council.

Official hotel headquarters for the conference will be at the Palmer House, where the entire fourth floor has been reserved for meetings, lunches and receptions. Meetings are open to all persons interested regardless of membership in the sponsor societies, but participating members must conform to registration rules.

Several committees already have started work for the four-day meeting. Sessions are being planned covering specialized activities such as heating, refrigeration, mining, electrical transmission and application, ventilation and coal utilization. Leaders of prominence in the various societies will be invited to participate by providing original papers or leading in the discussion. This meeting will have a wide appeal as it proposes a broad program of activities in many fields.

New Zealand Spending More on Power Developments

K. S. Williams, Minister of Public Works of New Zealand, in his recent annual statement, indicates that the projects now being undertaken will prove of great benefit in the development of the country's natural resources. The extension of hydro-electric services to primary producers and the im-

provement in rail and road access have tended to increase export trade, he said.

Mr. Williams anticipates that the expenditure during the current year on hydro-electric works in New Zealand will be £1,260,000 ($6,300,000) this providing for the completion of the Arapuni power station. The new Waitaki electric development in the South Island is expected to be completed within three years. The figures of expenditure considerably exceed those of 1927.

Water Power Italy's Chief Source of Electricity

About 98 per cent of the total electrical energy consumed in Italy during the first quarter of 1928 was generated by water power, and about 2 per cent was steam generated, according to a report from Consul S. E. Redecker, Naples, Italy.

A total of 1,885,312,000 kilowatt-hours were consumed in Italy in the first quarter of 1928, compared with 1,779,945,000 kilowatt-hours in the corresponding period of 1927, indicating greater industrial activity this year. The consumption for the first quarter of this year was by far the highest of any similar period on record. Of the total energy consumed in the first quarter 1,818,064,000 kilowatt-hours or about 98 per cent were hydro generated and the remaining 37,248,000 were steam generated.

Grand Falls Hydro Plant Begins Operation

The Grand Falls, New Brunswick, hydro-electric plant of the Saint John River Power Company, a subsidiary of International Paper Company, began delivery of electric energy on Oct. 1, and became the largest hydro-electric plant in operation in the Maritime Provinces of Canada. Present at the ceremonies were Lord Willingdon, Governor-General of Canada, Doctor Baxter, Premier of the Province of New Brunswick, Mayor Collins of Grand Falls, and other notables.

Designed for 80,000 hp., the power house at Grand Falls has an initial installation of 60,000 hp. in three generators of 20,000 hp. each. The Saint John River Power Company has sold 20,000 hp. to Fraser Companies under a long-term contract and, except for a small amount for local distribution, has reserved the balance for the New Brunswick International Paper Company's new mill, which is being built at Dalhousie in the northern part of the Province.

The starting up of the Grand Falls station was coincident with the opening of the new Paugan, Quebec, hydro-electric plant of Gatineau Power Company, another subsidiary of the International Paper Company, of which mention was made last week in these columns. The International Paper & Power Company, the new holding company for the properties of International Paper Company, which is expected to hold a large majority of the common stock of New England Power Association, will have developed and under construction in the combined companies, water power developments of 1,300,000 hp. This total is capable of being increased through further development and through the utilization of undeveloped sites to a grand total of 2,600,000 horsepower.

New Tool Material Developed By General Electric

"Carboloy," a new metallic material only slightly softer than diamond and having half the mechanical strength of high-speed steel, was announced to the scientific and industrial world on Oct. 11 by Dr. Samuel L. Hoyt, research metallurgist of the General Electric Company, in a paper presented before the American Society for Steel Treating, in Philadelphia. Although the basic material from which this product is made is the notoriously brittle tungsten, the addition of cobalt, according to Doctor Hoyt, has given Carboloy properties that make it superior to all previous alloys for certain classes of machining work.

The new material will do lathe cutting upon a glass rod without becoming dull, or it may be used to drill concrete in the same way that tool steel drills brass. On the other hand, when used as a tool for cutting soft materials such as bakelite, carbon and the like, the new alloy resists the abrasive action of the soft material and can be used for long periods without resharpening. It is expected to be particularly valuable in the machining operations on commutators and on all parts in which a cut must be taken through a composite of soft and hard substances. Heretofore, cutting tools have been prone to "grab" or stick in passing from one metal to the other. Carboloy, however, is so hard and tough that it presents no difficulty in this respect.

In endeavoring to obtain a measure of the relative hardness of Carboloy, Doctor Hoyt said, the usual method of using the Rockwell tester was not possible, since the diamond point of the tester crumbled on striking the Carboloy sample. It was necessary to modify the apparatus in order to obtain reliable results. The final determination gave a hardness number of 2,000 as against 850 for tool steel and 1,000 for high-speed steel. Carboloy thus falls between diamond and sapphire in hardness.

The Sulphur Problem in Burning Coal

The clinkering of the ash in a furnace does not always vary directly with the sulphur content of the coal, states J. F. Barkley, in Technical Paper 436, recently issued by the United States Bureau of Mines, Department of Commerce. In common practice the sulphur content has been used as an index of clinkering tendencies, and for many coals it will serve fairly well for this purpose. The fusibility of coal ash depends upon such factors as the ratio of the silica to the bases, the nature of the bases, the percentage of aluminum, etc. When the ratio of the silica to the bases is very high or very low the ash-fusion temperature is high. When sulphur occurs in the coal as a component of iron pyrites, it indexes to a great extent the amount of the effective base, iron. When no iron is present, there generally exists a highly siliceous ash of high-fusion temperature. When much iron is present, the silica-base ratio is likely to be such that an ash of low-fusion temperature occurs. At times in fuel beds, because of lack of oxygen, the iron is oxidized to ferrous oxide, which forms, with silica, ferrous silicates that have a relatively low fusion temperature. Some coals quite low in sulphur have an ash of low fusion temperature due to the nature and relative amounts of their mineral constituents. Sulphur in the organic compounds undoubtedly has little or no effect on the clinkering.

A complete discussion of the sulphur problem in burning coal is given in the above-mentioned paper, which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 5 cents.

1928 Engineering Index Sets New Standard

The American Society of Mechanical Engineers reports that, since the inauguration of the Engineering Index Service in January of this year, this comprehensive index to all technical periodicals has gained recognition and support from many industries, both domestic and foreign.

The old annual index, in volume form, contained from 18,000 to 20,000 items, whereas the new service has annotated nearly 32,000 articles in the first nine months of its existence and the original estimate of 50,000 items per year is, apparently, not amiss. The service in its present form is a complete index to all current technical periodicals from thirty-seven countries. In it one finds a complete résumé of all published technical information with the assurance that further search is unnecessary.

U. S. Bureau of Mines to Investigate Inerts in Coal

An investigation of the effect of inerts in coal on its utilization has just been undertaken by the United States Bureau of Mines at its Pittsburgh Experiment Station. This work, which is being done in co-operation with the Carnegie Institute of Technology and the Pittsburgh Coal Company, will deal primarily with the effect of "fusain" or mineral charcoal on coking properties of coal and with the effect of ash constituents on clinker formation. Several mines of the Pittsburgh bed have been sampled and the coal benches analyzed separately for distribution of inert matter.

Japanese Prince Will Lead World Engineering Congress in Tokio Next Year

Prince Chichibu, brother of the Emperor of Japan, has been named Honorary President of the World Engineering Congress to be held in Tokio in 1929, according to advice just received by Elmer A. Sperry, chairman of the American Committee to the Congress.

As patron of this gathering of international scientists, the Prince will take an active part in preparing for the Congress which, it is expected, will be attended by a large body of the most eminent American engineers. The interest which Japan is showing in the American representation, was evidenced by Ambassador Matsudaira, who, prior to his departure from Washington, was host at a dinner to members of the American Committee.

That the United States will probably have the largest delegation to the Congress and that the Japanese engineers are making lavish plans for their entertainment, was revealed by Maurice Holland, executive secretary of the American Committee. More than fifty American engineers from all sections of the country have already made reservations to attend the Congress. Mr. Holland said.

"Word has been received," Mr. Holland declared, "that the Prime Minister of Japan will be the host at a dinner to the delegates, and other officials of the government will preside at functions being planned for the visiting engineers. Also that the Imperial Government Railway will furnish free transportation for the visitors."

Herbert Hoover is Honorary Chairman of the American Committee.

Committee to Standardize High-Pressure Unions

In March, 1928, the American Engineering Standards Committee was requested by the Heating and Piping Contractors National Association and the American Society of Mechanical Engineers to authorize the standardization of malleable iron brass seat unions for high pressures. These organizations maintained that this item was naturally included within the scope of the Sectional Committee on the Standardization of Pipe Flanges and Fittings.

It will be recalled that this sectional committee was organized under the procedure of the A.E.S.C. with the H.P.C.N.A., the Manufacturers Standardization Society of the Valve and Fittings Industry and the A.S.M.E. as joint sponsors. It is composed of 56 members officially representing 10 technical societies, 14 trade associations and 5 government bureaus, or, analyzed another way it consists of 18 manufacturers, 32 consumers and 6 general interests. In other words, it constitutes a very representative cross-section of this American industry. On July 28, 1928, the A.E.S.C. indorsed the suggestion of the sponsors relative to the allocation of this project.

In connection with this standardization activity it is interesting to note that a committee of the A.S.M.E. developed a standard for malleable-iron pipe unions in 1901 in conjunction with similar committees of the American Railway Master Mechanics' Association and the Master Car Builders' Association.

A new subcommittee to be known as subcommitee No. 6 is accordingly being formed to take up the work of developing an American standard for high-pressure malleable-iron brass-seat unions.

Fifteen Mile Falls Project Under Way in Vermont

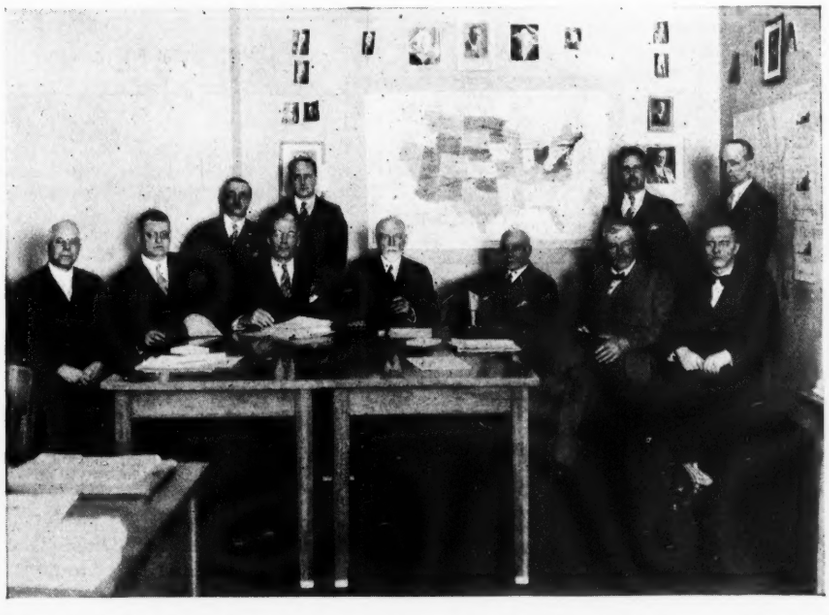
Ground has just been broken by the New England Power Association for a dam and power house at Fifteen Mile Falls on the upper Connecticut River near St. Johnsbury, Vt. The project calls for an ultimate development of 300,000 hp. to be generated at two stations situated seven miles apart at a point where there is a steep slope in the river bed. Much of the work to be done immediately is common to both stations, but the first to be finished will be the lower development, the date for the completion of which is set for the fall of 1930.

At the lower development a dam 170 ft. high will be built at a point practically at the foot of the falls. This is to be of the modified hydraulic filled earth type on the New Hampshire side, and a concrete spillway section on the Vermont side, with the power house in the river bed. The dam and spillway at this development will be about 2,300 ft. long, with a maximum width of the earth dam of 1,000 ft., and a width at the crest of about 25 feet.

The railroad, which the Association is now building from the main line of the Canadian Pacific near Inwood Station, Vt., will be permanently located on the top of this dam, so as to provide a method for getting material in and out during construction and after the power house is in operation. The length of the spillway section is in the neighborhood of 865 ft. The reservoir created by this dam will be some eight miles long and will cover an area of 1,100 acres (about two square miles). This reservoir will have a capacity of approximately 55,000 acre-feet, or eighteen billion gallons. The net average head will be 164 ft., which will develop 120,000 kw. in four generators of 30,000 kw. each.

At the upper development there will be a dam approximately 175 ft. high, having a width at the base of 1,000 ft. and at the crest of 25 ft. At this dam the length of the crest is some 3,300 ft. over-all, and the elevation 820 ft., roughly, above sea level. This dam will create a reservoir having a capacity of 73.5 billion gallons, and will drain an

Engineers Enter Presidential Campaign



The executive committee of the Hoover-for-President Engineers' National Committee. From left to right: Roy V. Wright, managing editor of "Railway Age"; N. A. Carle, consulting engineer; F. D. Farish, secretary of the committee; Byron E. Eldred, engineer; J. A. Dewhurst, executive secretary of the committee; James H. McGraw, president of the McGraw-Hill Publishing Company; J. V. W. Reynders, chairman of the executive committee; Allen Hazen, G. W. Herron and Samuel H. Dolbear, consulting engineers, and H. Foster Bain, secretary of the American Institute of Mining Engineers

area of 1,613 square miles. The reservoir will be twelve miles long and quite irregular in shape. The water at the power house will be conducted through penstocks 21 ft. in diameter and will generate 105,000 kw. in four units.

L. C. Morrow Appointed Editor of *Industrial Engineering*

The editorial board of McGraw-Hill Company has just appointed L. C. Morrow to the position of editor of *Industrial Engineering*, one of the McGraw-Hill group of publications. Mr. Morrow at the time of his appointment was managing editor of *American Machinist*.

He is a graduate in mechanical engineering, University of Cincinnati, 1912. After graduation he had several years of industrial plant experience and was given a number of important assignments during the war. He joined the editorial staff of *American Machinist* in 1920 and shortly thereafter was appointed managing editor. In this position he assumed duties of great responsibility when his publication was dealing with difficult post-war problems.

In his new position, which he will assume on Nov. 1, Mr. Morrow takes editorial charge of a publication established in recent years to fill a new need in industry. Under his leadership it is confidently expected that *Industrial Engineering* will go forward to still larger achievements.

Screw-Thread Standards Again Revised

Changes and additions have recently been made by the National Screw Thread Commission to its 1924 report. Several screw-thread standards, which were then in the early stages of development, have been completed, and some revision of the original standards has been made. The second revision of the report of the commission, which is to be known as the 1928 report, has now been prepared and approved for publication, and is about to be placed in the hands of the public printer.

The general arrangement of the 1924 report has been retained with the addition of sections covering the following items: Wrench head bolts and nuts and wrench openings; other screw, bolt and nut proportions by reference to certain specifications of the American Engineering Standards Committee and the Federal Specifications Board; standard practice for Acme screw threads; screw threads for oil country drilling equipment by reference to specifications published by the American Petroleum Institute; standard hose connections for welding and cutting torches; rolled threads for screw shells of electric sockets and lamp bases; and a 12-pitch thread series for special applications.

All matter pertaining to threading tools has been removed from the specifications, but is included in the appendix.

Coming Conventions

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Institute of Refrigeration, at Washington, May, 1929. Louis Baron, secretary, 203 West 13th St., New York City.

American Society of Refrigerating Engineers, at New York City, Dec. 2-6, 1928. David S. Fiske, secretary, 37 West 39th St., New York City.

American Refractories Institute, fall meeting, New York City, Oct. 24, D. A. Texter, secretary, 2202 Oliver Building, Pittsburgh, Pa.

Master Boiler Makers Association, at Atlanta, Ga., May 21-24. H. D. Vought, secretary, 26 Cortlandt St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Other new material added to the appendices includes the following as useful information: American gage design committee standard designs of blanks for plain and threaded plug and ring gages; specifications covering class 5, wrench fit for threaded studs; common practice as to thread series and class of fit for screws, bolts and nuts; and wire methods of measurement of thread thickness of Acme threads.

Obituary

Brigadier-General William Bixby, retired, former chief of Army engineers and one of the developers of the Mississippi Flood Control Works, died on Sept. 29 in Washington, D. C., after a brief illness. He was 75 years old. General Bixby had a distinguished career which led him into widely varied service for his country. He was born in Cambridge, Mass., on Dec. 27, 1849, and studied at Massachusetts Institute of Technology for two years, when he was appointed to the United States Military Academy, from which he was graduated in 1873. He was identified with many important engineering works in the United States, principally in connection with the improvement of the Mississippi River, other river and harbor work and also the development of the water-supply system of the District of Columbia. He was responsible for the removal of the wreck of the Battleship "Maine" from Havana Harbor in 1912. He received the rank of brigadier-general on June 12, 1910. He was Chief of Engineers from June 10, 1910, to Aug. 11, 1913, when he retired. He returned to active service from May, 1917, to April, 1919.

Robert Laidlaw, founder of Laidlaw & Dunn, now the Worthington Pump & Machinery Corporation, New York City, died Oct. 6 at Brockville, Ont., in his eightieth year. Mr. Laidlaw was active in business and civic circles in Cincinnati, Ohio, until his retirement in 1899. He was at one time superintendent of the water-works in Cincinnati and later, with his brother and J. W. Dunn, he operated for many years the firm of Laidlaw & Dunn.

Society Affairs

American Engineering Council—The next meeting of the Administrative Board will be held in Pittsburgh, Oct. 19 and 20. President A. W. Berresford will preside.

A.I.E.E.—The Regional Meeting of the Southern District will be held at Atlanta, Ga., Oct. 29-31. O. O. Rae, 426 Marietta St., Atlanta, heads the registration committee.

A.S.M.E., Dayton, Ohio, section, will hold a meeting on Oct. 24 at the Engineers' Club of Dayton. The speaker will be Alex Dow, president of the national society. Mr. Dow will give an informal talk on a subject which has not yet been announced.

Personals

Robert Ridgway, chief engineer for the New York City Board of Transportation, has recently been chosen one of a group of five specialists to serve on the Boulder Dam Commission.

F. S. Broadhurst, who recently retired from Starkweather & Broadhurst, Inc., of Boston, Mass., has joined the Turbine Equipment Company, also of Boston, as its president.

F. R. Fishback, president of the Electric Controller & Manufacturing Company, Cleveland, Ohio, has just been elected vice-president in charge of the apparatus division of the National Electrical Manufacturers' Association, according to an announcement made by A. E. Waller, managing director of the association.

Walter G. Hildorf has been placed in charge of all metallurgical work for the Timken Steel & Tube Company, at Canton, Ohio. For several years Mr. Hildorf has been metallurgical engineer for the Reo Motor Car Company, Lansing, Mich.

A. L. Struven, who has been chief engineer of the Terminals & Transportation Corporation of America, in charge of engineering and construction,

is now associated with the Walbridge, Aldinger Company of Detroit, Mich., general contractors and engineers, as construction engineer.

D. L. FAGNAN has resigned as service engineer of the Smoot Engineering Corporation, of New York City, and has entered the hardware business, setting up an establishment under the name of the East Elmhurst Hardware Company, at East Elmhurst, Long Island, N. Y.

PAUL E. GOOD, until recently vice-president of the Ratteau Battu Smoot Company, has been appointed manager of the centrifugal blower and compressor department, Elliott Company, Philadelphia, Pa.

ARTHUR F. MURRAY, for the last twelve years with the East Springfield, Mass., works of the Westinghouse Electric & Manufacturing Company, has been appointed director of manufacturing operations on the staff of the general works manager, at the East Pittsburgh works of the company.

N. STAHL, formerly of the United Public Service Company, Chicago, Ill., has been made manager of engineering and construction of the Penn Power & Light Company, Allentown, Pa.

BUSINESS NOTES

THE JEFFERSON UNION COMPANY has moved its main offices from Lexington, Mass., to New York City. The new address of the company will be 11 West 42nd Street.

THE KROESCHELL BOILER COMPANY is the new name under which has been incorporated the manufacturing business in power and heating boilers formerly conducted by the Brunswick-Kroeschell Company of Chicago, Ill. Kroeschell water-tube and greenhouse boilers will be manufactured by the new organization at the same plant as before.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces the appointment of N. L. Mortensen as chief engineer of the organization. Mr. Mortensen will take the place of T. E. Barnum, former chief engineer, who has been made consulting engineer for the company.

THE GLASGOW IRON COMPANY announces the removal of its Philadelphia offices to Pottstown, Pa.

FOOTE BROS. GEAR & MACHINE COMPANY announces the appointment of A. H. Tischer, 704 No. Alabama St., Indianapolis, Ind., to represent the company in the Indiana territory south of the line drawn below the City of Fort Wayne, Ind., and also including the City of Louisville, Ky.

THE NORDBERG MANUFACTURING COMPANY, of Milwaukee, Wis., announces that it has consolidated with the Symons Brothers Company, of Chicago, Ill., and will increase its manufacturing facilities at Milwaukee so as to handle the latter company's business.

TRADE CATALOGS

INDUCTION MOTORS—The Reliance Electric & Engineering Company, Cleveland, Ohio, has recently issued eight-page bulletin No. 103, describing a line of fully inclosed fan-cooled induction motors provided with ball bearings. The bulletin contains descriptive text and illustrations, dimension diagrams and tables, and cross-sectional drawings showing the flow of cooling air.

CONCRETE INSERTS—"Adjustable Inserts" is the title of a new leaflet, No. 20383, just issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It describes briefly the construction and use of a new type of metal part designed to be cast into concrete walls, ceilings or foundations, to give footing for bolts.

OVERHEAD CARRYING EQUIPMENT—The Cleveland Tramrail division of the Cleveland Crane & Engineering Company, Wycliffe, Ohio, has just issued a large general catalog, No. 4, which is made up of bulletins issued by the company in the last few months. In this catalog are described and illustrated all kinds of overhead tramrail equipment and supplementary apparatus.

FURNACE INSULATION—Bulletin No. 108, issued by the Celite Products Company, Los Angeles, Calif., describes the use of "Sil-O-Cel" in the insulation of industrial furnaces and ovens. Numerous cross-sectional drawings and halftones in this catalog show the method of insulating various types of furnaces.

MECHANICAL EQUIPMENT — The A.S.M.E. has just issued its annual condensed catalog of mechanical equipment. This volume, as in previous years, contains descriptive matter and cuts covering the products of manufacturers of engineering equipment, and is in every sense complete. At the back of the book, in addition to a complete index known as the mechanical equipment directory, there is also a professional engineering service directory listing the engineering firms that make a specialty of each field. The volume contains 1022 pages and is free to members of the society. It is obtainable by others for $5 from the secretary of the society at 29 West 39th St., New York City.

INDUCTION MOTORS—The General Electric Company, Schenectady, N. Y., has issued a two-page bulletin, GEA-711-B, describing and illustrating a line of small wound-rotor induction motors in the power range of three-fourths to ten horsepower. The motors are manufactured in three- and two-phase models, and for 220-, 440- and 550-volt ratings.

FOUNDRY PRACTICE—Four-page Bulletin No. 18, just issued by the Lebanon Steel Foundry, Lebanon, Pa., describes and pictures the processes and equipment with which this company produces metal castings by the electric furnace method. The bulletin is one of a series discussing the problems of the purchaser of castings.

STEAM PURIFIER—Under the title, "Something New About a Cubic Foot of Steam," the Andrews-Bradshaw division of the Blaw-Knox Company, Pittsburgh, Pa., has issued a 6-page folder setting forth pictorially and in caption the advantages of the "Tracyfier" in eliminating moisture and dirt from steam as it leaves the boiler. The publication is known as Bulletin No. 1050.

COMPRESSORS—The Chicago Pneumatic Tool Company, Chicago, Ill., has issued a 24-page bulletin No. 720, which goes into the subject of air and gas compressors thoroughly, employing many illustrations, diagrams and tables. Details of construction and installation information, are also given.

CENTRIFUGAL FIRE PUMPS—The application of centrifugal pumps to fire service both ashore and afloat is discussed and illustrated in a 36-page bulletin, No. 288-F, just issued by the Byron-Jackson Pump Company, of Berkeley, Calif. Considerable useful information as to installation and operation is also given in this publication.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.30@$2.50
Kanawha	Columbus	1.25@ 1.60
Smokeless	Cincinnati	1.75@ 2.25
Smokeless	Chicago	1.75@ 2.25
S. E. Kentucky	Chicago	1.50@ 1.75
Steam	Pittsburgh	1.40@ 1.90
Gas Slack	Pittsburgh	1.15@ 1.25
Big Seam	Birmingham	1.25@ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.90@$3.00
Barley	New York	1.50@ 1.75

FUEL OIL

New York—Oct. 11, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4¾c. per gal.; 36@40 deg., furnace, tank-car lots, 6½c. per gal.

St. Louis—Sept. 26, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.346 per bbl. or 42 gal.; 26@28 deg., $1.396 per bbl.; 28@30 deg., $1.446 per bbl.; 30@32 deg., $1.496 per bbl.; 32@36 deg., gas oil, 4.151c. per gal.; 38@40 deg., 5.23c. per gal.

Pittsburgh—Oct. 1, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5¼c. per gal.

Philadelphia—Oct. 3, 26@30 deg., $1.89@$1.96 per bbl. or 42 gal.; 13@19 deg., $0.95@$1.02 per bbl.; 22 plus. $1.43@$1.50 per bbl.; 27@30 deg., $2.00@$2.07 per bbl.

Cincinnati—Oct. 8, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Oct. 6, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 57½@ 60c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., 95c. per bbl.

Boston—Oct. 8, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.45c. per gal.; 28@32 deg., 5.6c. per gal.

Dallas—Oct. 6, f.o.b. local refinery, 26@30 deg., $1.15 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Colo., Alamosa—Public Service Co., 15th and Champa Sts., Denver, is having preliminary plans prepared for the construction of a 33 x 96 ft. power house including turbine to develop 1,500 kw. and 500 hp. Sterling boiler, here. Estimated total cost $140,000.

Ill., Chicago—Bogeaus Construction Co., 180 North Michigan Ave., B. E. Bogeaus, (general contractors) receiving bids for the construction of a 20 story apartment building at Wrightwood Ave. and Hampden Ct. R. Gregori, 134 North La Salle St., is architect.

Ill., Chicago—P. F. Olsen, 720 Cass St., Archt., is receiving bids for the construction of two 6 story apartment buildings including mechanical refrigeration system, elevators, etc. at 74th St. and Phillips Ave. for J. J. Cundy, 6759 Cornell Ave. Estimated cost $600,000.

Ill., Chicago — Wieboldt Stores, W. A. Weiboldt, Pres., 1279 Milwaukee Ave., plans the construction of an 8 story department store at West 63rd and Green Sts. Estimated cost $2,000,000. Architect not selected.

Ill., Jacksonville—City awarded contract for the construction of a sewage disposal plant including pumping station, etc., on North Side, to R. McCalman, Inc., Danville. Estimated cost $124,286.

Ind., Fort Wayne — Lincoln National Bank & Investment Co., is having plans prepared for the construction of a 22 story bank and office building including steam heating and ventilation systems, elevators, etc. at Court and Barry Sts. Estimated cost $1,000,000. A. M. Strauss, 415 Cal-Wayne Bldg., is architect.

Ky., Paducah — City postponed date of bond election for $800,000 bonds for the construction of a municipal power plant. Burns & McDonnell Engineering Co., 401 Interstate Bldg., Kansas City, Mo., is engineer. New date soon.

Mass., Andover — Phillips Andover Academy, J. H. Buttiner, Supt. of Bldgs., awarded contract for the construction of a power house on Academy grounds, to E. W. Pitman Co., Bay State Bldg., Lawrence. Estimated cost $40,000.

Mass., Falmouth—S. T. Cahoon, Woods Hole, had plans prepared for the construction of an ice and cold storage plant on Sippewissett Rd., here. Estimated cost $40,000. W. A. Gifford, Falmouth, is engineer.

Mass., Nantucket—City awarded contract for the construction of a pumping station in connection with sewerage system, to J. E. Ballentine, 79 Sudbury St., Boston, Mass. Estimated cost $35,000.

Mich., Detroit — Smith, Hinchman & Grylls, 800 Marquette Bldg., Archts., will receive bids about Oct. 12, for the construction of a maternity home, including steam heating and ventilation systems, boilers, elevators, etc., at Wodrow Wilson Ave., for Florence Crittenden Home, 583 Elizabeth St. Estimated cost $700,000.

Mich., Morley — Stevens & Wood, 120 Broadway, New York, N. Y., Engrs., are making preliminary studies and plans for the construction of a hydro-electric power dam, 1,000 ft. long to develop 35,000 hp. here for Consumers Power Co., 244 West Michigan Ave., Jackson.

N. J., Newark—Public Service Electric & Gas Co., 80 Park Pl., will receive bids about Oct. 15, for the construction of a 40 x 70 ft. sub-station at 1223-1229 Broad St. Estimated cost $60,000. Public Service Production Co., 80 Park Pl., is engineer.

N. Y., New York—Bd. of Health, 505 Pearl St., awarded contract for additions and alterations to transformer building, also light and power system additions at Riverside Hospital, North Brother Island to Fischbach & Moore, Inc., 226 East 41st St. Estimated cost $24,640.

O., Barberton—Henry Coal & Ice Co., 400 East Baird Ave., plans the construction of an ice plant at Baird Ave. and Bolivar Rd. Estimated cost $85,000.

O., Wilberforce—Bd. of Trustees, Wilberforce University, J. L. Johnson, Chn., 1375 East Long St., is having plans prepared for the construction of a 47 x 85 ft. power house. Estimated cost $60,000. H. R. Briggs, Ohio-Hartman Bldg., Columbus, is engineer.

Okla., Maud—City, F. Fowler, Clk., will soon award contract for waterworks improvements, including 70 g.p.m. deep well pump and motor, mains, etc. Estimated cost $40,000. Long & Co., Colcord Bldg., Oklahoma City, are engineers.

Okla., Tulsa — C. H. Allbert is having preliminary plans prepared for the construction of a 75 ton raw water ice plant. Private plans.

Pa., Philadelphia — Gulf Refining Co., Girard Point, plans the construction of a 45 x 108 ft. boiler house at Penrose Ferry. Estimated cost $28,000. Private plans.

Tex., Dallas—City, c/o E. Goforth, Secy., will receive bids until Oct. 22, for waterworks improvement including storage reservoir and pumping station. Estimated cost $200,000. D. Morey, Jr., 417 Praetorian Bldg., is engineer.

Tex., Paris — Pennington Produce Co., Sulphur Springs, plans the construction of a poultry dressing plant and ice and cold storage plant here. Estimated cost $25,000. Private plans.

Tex., Temple—T. V. Lawson, 236 Cumberland St., San Antonio, plans the construction of a 40 ton ice plant, electrically operated, here. Estimated cost $45,000.

Ont., Niagara Falls—Hennepin Hotel Co., Ltd., awarded contract for the construction of a 7 story hotel at River Rd. and Queen St., to J. W. Butler Co., Ltd., Royce Bank Bldg., Toronto. Estimated cost $750,000. Steam heating system, elevators, etc. will be installed.

Ont., St. Catharines—Silverwoods Ltd., A. E. Silverwood, Mgr., London, is having plans prepared for a 2 story, 98 x 100 ft. dairy products plant, including refrigeration plant, here. Estimated cost $75,000. F. F. Saunders, 116 Concord Ave., Toronto, is architect.

Que., Buckingham—D. MacLaren, et al, are having plans prepared for a hydro-electric development at High Falls on Lievre River near here, 160,000 to 225,000 hp. capacity. Plans include a large dam and power house. Estimated cost $1,500,000.

Equipment Wanted

Boilers—U. S. Veterans' Bureau, Washington, D. C., will receive bids until Oct. 23, for retubing four horizontal return tubular boilers at U. S. Veterans' Hospital, St. Cloud, Minn.

Motors—Pollock Welker Ltd., 480 Victoria St., Kitchener, Ont., prices and catalogs on electric motors, etc., for radio equipment factory. Estimated cost $25,000.

Pumping Unit—Dept. of Water Supply, Detroit, Mich., will receive bids until Oct. 17 for a 10,000 g.p.m. motor driven centrifugal pump with auxiliary equipment for proposed waterworks improvements.

Pumping Units, Turbine, etc. — Bd. of Water Commissioners, J. Sheahan, Gen. Supt., Memphis, Tenn., will receive bids until Nov. 7 for a reduction gear driven centrifugal pumping unit with condensing auxiliaries, one 1 m.g.d. secondary hydraulic driven pumping unit, and one 15 m.g.d. steam turbine for Parkway pumping station, North Parkway and North Dunlap Sts.

Pumps, etc.—City of Gypsum City, Kan., will receive bids about Oct. 15, for one 50 g.p.m. vertical and one 300 g.p.m. horizontal centrifugal pumps, etc., for proposed waterworks improvements. Estimated cost $55,000.

Pumps, etc.—City of Wheatley, Ont., will soon receive bids for electrically driven centrifugal pumps, etc., for proposed waterworks plant. Estimated cost $50,000.

Industrial Projects

Calif., Oakland — BOOK FACTORY — Sunset-McKee Sales Book Co., c/o Ellison & Russell, Pacific Bldg., San Francisco, Engrs., is having plans prepared for a 1 story, 160 x 200 ft. factory at Livingston and Cotton Sts., here. Estimated cost $60,000.

Conn., Waterbury — BRASS TUBING FACTORY—French Mfg. Co., 128 Robbins St., awarded contract for a 1 story, 60 x 200 ft. factory to Torrington Building Co., 182 Church St., Torrington. Estimated cost $50,000.

Ind., Indianapolis—CARBURETOR FACTORY—Wheeler-Schebler Co., 1302 Barth Ave., awarded contract for the construction of a carburetor factory to Schlegel & Roehm, 602 Lexington Ave. Estimated cost $50,000.

Ind., Indianapolis—FACTORY—Link-Belt Co., Holmes and West Michigan Sts., awarded contract for a 3 story factory, to Latham & Walters, 204 Empire Life Bldg. Estimated cost $150,000.

Mass., New Bedford — WOODSCREW FACTORY — Continental Wood Screw Co., P. Sweeney, Mt. Pleasant St., had plans prepared for a 2 story, 60 x 100 ft. factory. Estimated cost $50,000. Leary & Walker, Union St., are architects.

Mich., Detroit — AUTOMOBILE TESTING BUILDING — Graham Paige Motors Corp., 8505 West Warren Ave., had plans prepared for a 2 story, 100 x 480 ft. auto testing building at Lonyo Rd. Estimated cost $200,000. Private plans. Equipment will be required.

Mich., Detroit—ELECTRICAL SUPPLY FACTORY—Lincoln Mfg. Co., 2630 Erskine St., awarded contract for a 4 story, 85 x 100 ft. factory for the manufacture of electrical supplies on Chene St., to Lerner-Sobel Co., 510 Book Bldg. Estimated cost $70,000.

Mich., Detroit — AUTOMOBILE PARTS FACTORY — J. M. Smith Co., 5914 Federal Ave., awarded contract for a 2 story, 80 x 150 ft. factory to W. E. Wood Co., 1805 Ford Bldg.

O., Cleveland — FACTORY — Western Reserve Mfg. Co., 3710 East 93rd St., (machinists) awarded contract for a 1 story, 32 x 110 ft. factory to Truscon Steel Co., 4614 Prospect Ave. Estimated cost $40,000.

O., Columbus—FURNACE FACTORY—Armstrong Furnace Co., awarded contract for a 1 story furnace factory to Rust Engineering Co., American State Bank Bldg., Pittsburgh, Pa. Estimated cost $50,000.

Tex., Longhorn—CEMENT PLANT—Republic Portland Cement Co., W. M. Thornton, Mgr., c/o Smith Bros. Properties Inc., 121 Villita St., San Antonio, will build a cement plant near here. Estimated cost $200,000. Terrell Bartlett Engrs., Calcasieu Bldg., San Antonio, are engineers. F. D. Sayers in charge.

Tex., Port Aransas—GASOLINE CRACKING PLANT—Humble Oil & Refinery Co., Aransas Pass, will build a gasoline cracking plant here. Estimated cost $1,000,000. Private plans.

Vt., St. Johnsbury — FORK and HOE FACTORY — American Fork & Hoe Co. awarded contract for a 1 and 2 story factory building and power plant at 8 Ely St., to J. M. Swan & Sons, 144 Portland St.

Ont., Oakville — METAL FACTORY — General Metal Devices, Oshawa, awarded general contract for a 1 story, 60 x 300 ft. metal factory on Kerr St. here, to W. W. King, Oakville, Ont. Estimated cost $75,000.

Ont., Toronto—STEEL PLANT ADDITION—Dominion Bridge Co., Ltd, Reford Bldg., awarded general contract for a 1 story addition to steel plant on Sorauren Ave. to Dickie Construction Co., 17 Yorkville Ave. Estimated cost $150,000.